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# Recording and amplifying of the accordion

What is the best way to capture the sound of the  
acoustic accordion?

**SOUNDING PART.zip** - *Sounding part of the thesis:*  
*D. Scarlatti - Sonata D minor K 141, V. Trojan - The Collapsed Cathedral*

**SOUND SAMPLES.zip** – *Sound samples*

## **Declaration**

I declare that this thesis has been solely the result of my own work.

*Milan Řehák*

## Abstract

In this thesis I discuss, analyse and intend to answer the question: What is the best way to capture the sound of the acoustic accordion? It was my desire to explore this theme that led me to this research, and I believe that this question is important to many other accordionists as well. From the very beginning, I wanted the thesis to be not only an academic material but also that it can be used as an instruction manual, which could serve accordionists and others who are interested in this subject, to delve deeper into it, understand it and hopefully get answers to their questions about this subject. The thesis contains five main chapters: Amplifying of the accordion at live events, Processing of the accordion sound, Recording of the accordion in a studio - the specifics of recording of the accordion, Specific recording solutions and Examples of recording and amplifying of the accordion in practice of other accordion players, and two recordings: D. Scarlatti - Sonata D minor K 141, V. Trojan - The Collapsed Cathedral. My aim is that this thesis will contribute to create a comprehensive insight into the specifics of capturing the accordion sound, contribute to better understanding of the acoustic properties of the instrument and bring practical answers to questions that many accordionists have. I have chosen to mention very basic technical aspects related to how to capture the sound of the acoustic accordion with respect to potential elementary knowledge of some people in this area. But, I also discuss very specific and professional details and focus on how different kinds of microphones can be used to capture the sound of the acoustic accordion. This is a subject that clearly is understudied and probably not has been a matter for proper research before. Most of my comments and analysis come from my personal experience and different experiments but there is also an interview included in the thesis with one very experienced accordionist who also is a professional music producer. I hope that my thesis will help other accordionists, sound engineers, and anyone else to understand the accordion and its specifics regarding both studio recording and live amplifying.

## Keywords

Accordion, recording, amplifying, microphones, studio, live music

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# 1 Introduction

Today's musical world presents a huge number of separate and closely intertwined styles, genres, traditions and tastes. We hear or listen to music in almost every situation of our lives - in chamber music halls, on big concert stages, on the streets, on television, on radio, and of course, do not forget hundreds of millions of different audio players. Of course, almost nothing can be compared to the natural acoustic sound of a great concert instrument in a well-balanced and well-sounding space, but the present day and age dictates its conditions to musicians, so we can come across a lot of amplification and artificial changes of the sound. In addition, the distribution of music through recordings, such as CD, MP3, digital streaming and downloading, etc. is the most common and most widely used way of spreading and popularizing of music. Modern technologies also allow us to experiment with the sound of the instrument, to find new colours, sounds, and new possibilities of musical expression, both in live performances and during recording.

I would like to dedicate this work and research to amplifying and recording of the accordion as an instrument that has developed significantly in recent decades and years, and gains its position not only in classical music, but also in non-academic genres.

In the beginning of this thesis, I discuss the reasons that led me to this research and explain the personal background of my initiative. Throughout the whole thesis, I test different microphones and trying out different solution of recording of the accordion and capturing its sound in general, including measuring of technical properties of suitable microphones and different positioning of them.

An important part of this research is enclosed sound samples. I have made several reference recordings that serve as a 'tangible' material that I compare and give comments on through the thesis. Simultaneously, these musical samples give the reader an exceptional chance to hear many kinds of recording solutions, and in case you are an accordionist, you can compare these recordings too, make your own opinion on them and eventually use some of the solutions in your future projects.

**The audio samples are available on Diva and in this SoundCloud playlist online:**

→ <http://www.diva-portal.org>

→ <https://soundcloud.com/user-533583409/sets/recording-and-amplifying-of-the-accordion-milan-rehak-audio-samples>

This thesis is sorted into five main chapters: *Amplifying of the accordion at live events*, *Processing of the accordion sound*, *Recording of the accordion in a studio - the specifics of recording of the accordion*, *Specific recording solutions* and *Examples of recording and amplifying of the accordion in practice of other accordion players*.

Hopefully, all these parts create a comprehensive insight into the specifics of capturing the accordion sound, contribute to better understanding of the acoustic properties of the instrument and bring practical answers to questions that many accordionists have.

## 2 Personal background

As most of musicians, I very often get to situations when I need to capture the sound of my instrument. Probably the two most common examples of such situations are studio recording and amplifying of the instrument in live concerts. Compared to other instruments, the accordion might be quite tricky to amplify with microphones properly, because the design of the instrument is fairly

complicated. The accordion is an instrument that belongs to the group of aerophone instruments. *An instrument that produces sound by using air as the primary vibrating means.*<sup>1</sup>. By moving the bellows, the player creates a stream of air that shakes metal reeds inside of the instrument. The source of sound is therefore primarily located where the reeds are. A specific issue is the left-hand accordion manual because it is in a constant motion, which also complicates the sound recording. As a lot of other musicians, naturally, I started to be seriously interested in recording of my music at some point of my life. In my case, it was about three years ago before doing this research. When speaking about recording, the first bigger impulse to think more about this subject came with my first CD *Buttonfield*<sup>2</sup> that I recorded in a professional studio in summer 2016. By that time, I already knew some very basic things how to approach recording of my instrument, but it was not enough to consciously direct the whole process of recording and post-producing of the CD myself. Also, the audio engineer, as many other audio engineers, did not have any previous experience with recording of the solo accordion. It actually happens quite often, when recording in a studio, that local recording engineers really need an advice on microphone placing from the accordionist, and since accordionists are not always experts in this area, it can be tricky for both to find the best solution. All the pieces on the album have been recorded using seven different microphones placed around my instrument. It was not ideal, and I would have done it a bit differently nowadays, but it was good enough to capture the complex character of the instrument by then. Two main defects of this album are a little bit uneven sound of the left hand and quite unnatural artificial reverb. After this, I decided to purchase my own microphones and started to experiment. As an example of such beginnings, I can list albums *Baroque Beat*<sup>3</sup> and *Uncharted Waters*<sup>4</sup> which I recorded in summer 2017 with two microphones only and with minimal knowledge of audio post-production. In my opinion, there are many defects in terms of sound there which are not even worth to name here, but I was on my way to reach my desired accordion sound. As an example of my current solo recordings, I can name Vivaldi's *Storm - The Four Seasons*<sup>5</sup> which I recorded in summer 2018. This kind of sound is probably the best of all my previous officially released recordings, although, there are still some imperfections, especially when it comes to the quality of mastering. The sound on that recording is quite close to my own conception of an ideal accordion sound but, there is still so much to improve. It is a process and I believe that it will get an even better sound in the future. The second area where I have struggled to reach ideal sound was live amplifying of the accordion. Since the accordion is not an instrument of the orchestra, we usually play as soloists or together with other instruments in specific groups, live on bigger stages and in different rooms. Of course, when speaking about classical music, we seldom need any amplification since the accordion is not designed to play with a microphone, the natural sound is strong enough, but when playing some modern genres, we very often need to solve the question of amplification. And again, audio engineers are not usually prepared for proper picking up of the accordion as good as in case of other, more classical instruments. Then we usually have to improvise with available means on the stage. However, if we really want to have a great sounding amplified accordion, we have to come up, as many top accordionists in the world, with our own proved solution of accordion miking. This is not an easy task and it is a process that takes months and years to figure it out. Thus, I have decided to research and compare several ways and solutions of recording and amplifying of the accordion.

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<sup>1</sup> Aerophone. *OnMusic Dictionary* [online]. [quoted 2018-09-27]. Available from: <http://dictionary.onmusic.org/terms/94-aerophone>

<sup>2</sup> Milan Řehák. *Buttonfield* [CD]. Digital distribution only, Milan Řehák, 2016

<sup>3</sup> Milan Řehák. *Baroque Beat* [CD]. Digital distribution only, Milan Řehák, 2017

<sup>4</sup> Milan Řehák. *Uncharted Waters* [CD]. Digital distribution only, Milan Řehák, 2017

<sup>5</sup> Milan Řehák. *Storm (The Four Seasons)* [Single]. Digital distribution only, Milan Řehák, 2018

### 3 Method

In this thesis, I draw partly on my own experience with recording of the accordion, and partly on experiences and approaches of other accordion players. It is important to mention that some of the principals and solutions that I present in this research, regarding recording of the accordion, have been already discussed in connection with other, more traditional, classical instruments. Thus, on the first pages of this thesis, I use mostly an analytical method to discuss, compare and comment different parts of the subject, still based on my opinion and practical experiences of an accordionist. Further on, I give concrete examples and results of real practical experiments that I have done. In all the sound samples, I play my concert accordion *Armando Bugari* with the Czech reeds *Typo A Mano* by *Harmonikas* company.

### 4 Amplifying of the accordion at live events

Imagine the simplest version of an acoustic performance without any sound amplification. The performer plays on the stage, the live acoustic sound of the instrument is perceived by the listener without distortion, although the colour of the sound has its tinge depending on the acoustic and spatial characteristics of the room. In this case, the sound string is simple:

**Performer - space - listener**

In the case of amplification, the sound string is much longer:

**Instrument - space - microphone(s) - preamplifier, device for sound correction and effects (compressor, expander, equalizer, etc.), mixer - power amplifier – loudspeaker(s) - space - listener.**

Do not forget about a significant number of cables and connectors that connect all the devices. It is obvious that each part affects the quality and character of the sound heard by the listener, and naturally, the quality of the whole system depends on the quality of its weakest part. Therefore, it is very important that each component of the sound string is selected depending on the desired sound quality level. There is probably no point of using a cheap microphone and hi-end expensive speakers. And vice versa, it is pointless to use high quality microphones when reproducing the sound on a poor audio system. Everything depends, of course, on a creative intention and requirements of the artist, but it must be borne in mind that the final sound depends on all the components of the sound string, and it is important that all the devices in the string function perfectly and provide the purest and best audio transmission and processing.

#### 4.1 Microphone types

The first and perhaps most important element in amplification is a microphone. A performer who wants to find his or her desired sound will firstly deal with the problem of choosing microphones that will pick up his or her instrument, because especially the quality and performance of the microphones will have the most significant impact on the sound quality of the output.

We can divide the microphones into dynamic and condenser ones, depending on the method of transmission of the acoustic signal to the electrical signal. I suppose that this thesis will get in hands of accordionists in most cases, and accordionists are usually not recording engineers, thus I would like to very briefly explain some technical things regarding microphones. This basic knowledge of microphones and how they work is essential for further research.

##### 4.1.1 Dynamic microphones

Dynamic microphones are relatively inexpensive to manufacture and mechanically durable, and they can withstand extremely high sound pressure levels. These microphones are designed to capture especially louder sounds from shorter distances, however they provide a relatively weak output signal.

## 4.1.2 Condenser microphones

Compared to dynamic microphones, condenser microphones are more complex which is also reflected in their price. A condenser microphone can respond to much higher frequencies, transmitting it better than a dynamic microphone can do. Condenser microphones are very sensitive and have a very low noise level. Their frequency characteristics are balanced and often go beyond the boundaries of human hearing at both ends. When using such microphones in a humid environment, the microphone sensitivity may be reduced and in extreme cases, the signal may completely disappear. In other words, condenser microphones are considered to be the highest quality, and if the performer tries to capture the sound in all details, this type of microphone is highly recommended. In most cases, we will deal with condenser microphones because they better suit the needs of a professional accordionist.

Apart from dynamic and condenser microphones, there are also ribbon microphones out there. However, this type of microphones is not so common, and we seldom come across it. Nevertheless, ribbon microphones may be suitable for recording of the accordion as well, but we need to bear in mind that all ribbon microphones have a figure-of-eight polar pattern, thus it captures sound well on the front and rear side, and eliminates sound coming from the sides. For its unusualness, I have omitted ribbon microphones in this research; usage of condenser and dynamic microphones will be enough to demonstrate the specifics of recording of the accordion.

## 4.2 Microphone polar patterns

Microphones may capture sound from different directions and at different intensity depending on the size and construction. Microphone designers intentionally design the microphones with different characteristics in relation to the intended use. It is important to know that the directional characteristics of microphones are frequency dependent, which means that it usually occurs in high frequencies, while the lows remain unchanged (fig 1).

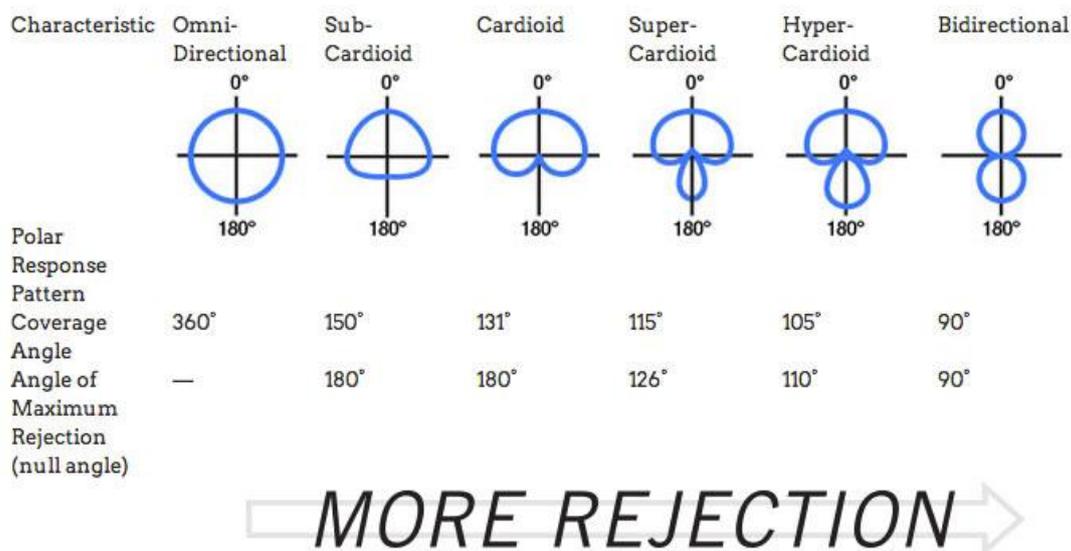


Figure 1: Overview of microphone polar patterns.

- **Cardioid:** The most common unidirectional pattern is the cardioid. This polar pattern offers a very good feedback rejection. We will be working with such a kind of microphone mostly when recording the solo accordion in a studio.

- **Supercardioid and hypercardioid:** As well as the cardioid microphone, both supercardioid and hypercardioid mics are suitable for recording in a studio but also for amplifying of live performances.
- **Subcardioid:** This polar pattern is prone to feedback since it captures also sound from the rear area.
- **Omnidirectional:** This polar pattern is prone to feedback. Both subcardioid and omnidirectional pattern may be good for recording of the accordion in halls with natural acoustics to reach more live sound. In some cases, they may be suited even for a studio use, especially as a room mic.
- **Bidirectional or figure-of-eight**

Since the accordion often does not play alone and it is necessary to capture the sound of the instrument without any external noise and sounds of other instruments, we are particularly interested in cardioid and hypercardioid microphones.

### 4.3 Distance of microphones from the instrument

First, I would like to state that dynamic microphones seem to be less suitable for capturing of the accordion sound. As I mentioned earlier, this type of microphone is not usually able to cover the whole frequency spectrum properly, which is essential to capture the real accordion timbre. And also, dynamic microphones respond better to close, louder sources of sound, which makes them unsuitable for recording of the accordion since they would capture more mechanical noise when placed too close to the instrument. Thus, if we really want to reproduce well the entire character of the accordion sound, we will need to use condenser microphones which can be placed further away and grasp the sound in its wholeness. However, there may be some exceptions. From my own experience, I know that when an accordionist plays live with a large amplified orchestra or a big-band orchestra, especially when drums are present there, we might want to use rather a dynamic microphone, at least for the right-hand manual, to avoid sound crossing of the other instruments. In this case, the dynamic microphone will help use to separate the accordion from other, louder instruments.

A crucial thing is the microphone sensitivity when speaking about the microphone distance. Microphone sensitivity is determined by measuring the output signal level for a certain sound pressure.

Both in recording and amplifying of the accordion, we can use basically three different types of microphones depending on the microphone distance from the instrument. Thus, I dared to group these microphones into three categories.

### 4.4 Microphones built into the instrument - inner microphone systems

Regarding microphones that are built into the accordion, I do not have a personal experience with this type of microphones on my concert accordion. However, I can draw on experiences of other accordionists that use such a solution, and also, I would like to present my opinion on this.

Several microphones, with relatively low sensitivity, are built directly into the accordion inside the right-hand manual part and the left-hand manual part near the sound source - reeds. The number of microphones and the distance between them is assembled so that the sound of the instrument has the same volume and quality over the entire range. The output piece often consists of a box with one or two volume controls (for the right and the left hand) and jack output. It is important to note that if we need to adjust the sound of the left and right hand separately, it is necessary not to connect everything to a single output, but to make two separate outputs. Two separate outputs are important for independent controlling of volume of the manuals. Of course, we can have a well-balanced inner microphone system on the accordion, thus the outputs are not essential but still, there are some situations where we appreciate the ability of controlling the volume, for example when playing as a

soloist with an orchestra where the right hand is preferred or in modern experimental music. After all, we have two hands and should perceive and treat the accordion as two separate instruments in some cases.

When using an inner microphone system, only the sound of the accordion will be captured and the sound of other instruments, if any, will not be captured. It is the safest sound system in terms of audio feedback. This is a good option of selecting microphones for performers who want to experiment a lot with sound using various effects and processors. I would also recommend these types of microphones to accordionists who play with other instruments that sound aloud, such as a drum set or an electric guitar playing rock music. However, there are two disadvantages of using this system. Since the microphone is located too close to the reeds, the sound of the accordion lacks the ‘room sound’, it is a bit dry and aggressive, which cannot be appreciated by artists trying to get the most natural timbre possible. Inner microphone systems almost always have to be treated with some EQ and effects adjustments. Another problem that may arise is that a relatively large number of microphones and wires will interfere with the movement of some parts of the accordion, which can result in damage to the instrument. Potential repair requires great caution and care. I personally know about cases when the musician had to step down from using this type of sensors due to constant problems with the instrument's mechanics. I have to say that the repair is not easy, and it takes a lot of time and great experience.

#### 4.4.1 Overview of some inner microphone systems for accordion

As examples of commercial inner microphone accordion systems, I can name these models:

##### **Musictech MT-04N** (*Figure 2*)



*Figure 2: Musictech MT-04N.*

All Musictech systems use microphone capsules from the German company Sennheiser. However, the polar patterns, as well as their frequency range, the manufacturer does not specify.

##### **LIMEX Micro Professional 4**

Limex company is quite famous since their system is used by the Finnish accordionist Kimmo Pohjonen.<sup>6</sup>

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<sup>6</sup> Limex MIDI Systeme für Akkordeon. [Http://www.lueschermusik.ch](http://www.lueschermusik.ch) [online]. [quoted 2018-09-27]. Available from: [http://www.lueschermusik.ch/home/produkte/akkordeon/mikrofonemidifrakkordeon/limex\\_midi.html](http://www.lueschermusik.ch/home/produkte/akkordeon/mikrofonemidifrakkordeon/limex_midi.html)

## TOTTER MIDI TM4-AKUSTIK

This system uses five sensors for the right hand and four sensors for the left one. The origins of the sensors and their directional characteristics, as well as the frequency range, the manufacturer does not specify.

### Acoustas AMx11HD (Figure 3)

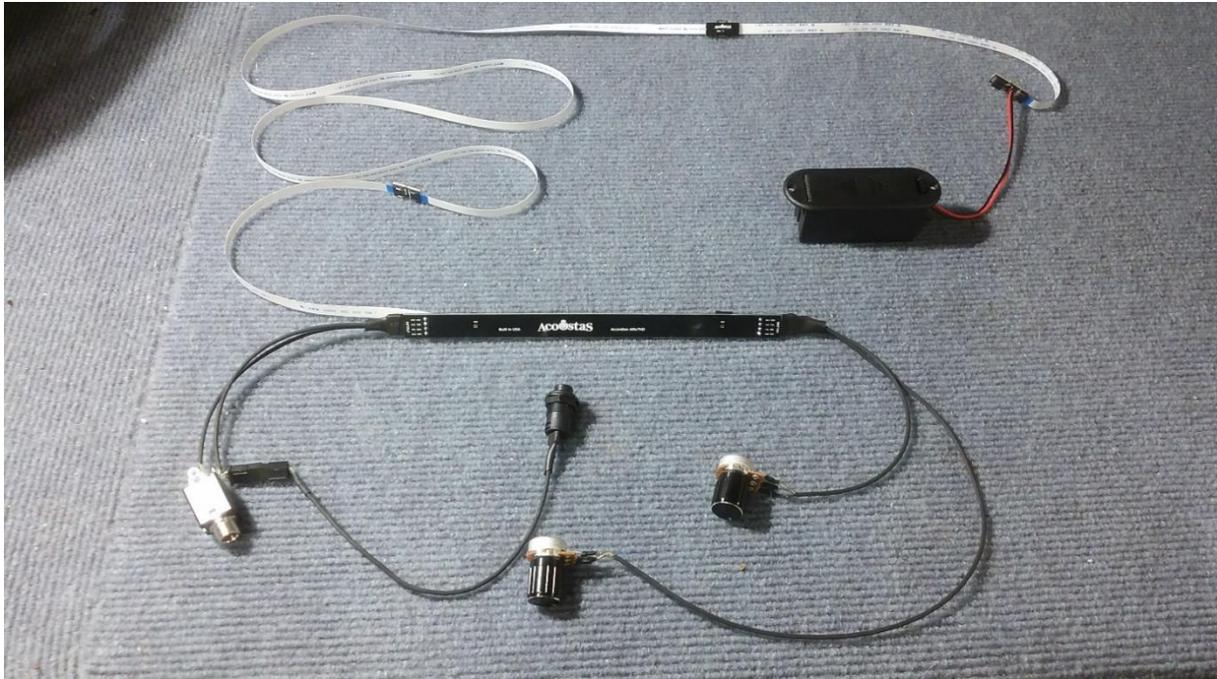


Figure 3: Acoustas AMx11HD.

This American company uses two sensors for the right hand and one sensor for the left hand. Nor frequency range and polar patterns are specified.

### Nalbantov Electronics AMP6S

This system has five sensors for the right hand and one sensor for the left hand. Nor frequency range and directional characteristics are specified.

In my opinion, inner microphone systems may be a very good option for someone who performs live together with other, mostly electric and loud instruments. However, it is not too suitable for recording because of the unnatural sound character, lack of the room sound, high self-noise, and usually a not high-end quality of sensors that are used in such systems.

## 4.5 Contact microphones on clips

(Shure MX185, Beyerdynamic Opus 86, DPA 4099, Audio-Technica ATM350, AKG C519ML and others)

Clip microphones represent a less radical way of accordion amplifying than the inner microphone systems. However, it can be sometimes tricky to fix the microphones on the instrument. And there are many different holders and ways to fix the microphones on, depending on each performer and his or her preferences. I would suggest having at least two microphones that are located directly outside of the instrument nearby the right-hand manual part and the left-hand manual. There may be more microphones, depending on the particular type and model, the sensitivity and directional characteristics have the most significant effect, and the size of the instrument. For example, for smaller accordions, often used in folk and singer-songwriter music, it is enough to use only two microphones –

one for each hand. Even for a bigger or a concert accordion we could use such a two-microphone solution but first, we should always focus on the right-hand manual; it is important for us to hear the whole range of the accordion well. It depends on models of microphones and concrete music that we play but it is often better to use two microphones for the right hand in order to cover the whole range evenly on a big concert accordion. If we place only one microphone on the right-hand manual to the middle, it can cause an unpleasant effect of increasing and decreasing of volume during the piece due to changeable distances of the sound source. Thus, if only two microphones are available in total, the microphone on the right-hand section must be in the middle of the manual. This will maximize the capture of the whole range, but before the concert, the microphone must be tried out in this regard. There are different holders on the market. In case of complex solutions for the accordion using clip microphones, manufactures attach holders for the microphones, but it means putting screws into the accordion in most cases, which is not my favourite option. In case we want to use different clip microphones that do not fit on such holders or just do not want to put any screws into our instrument, I would like to suggest my original holder, which I have invented, for the right hand (*Figure 4*).



*Figure 4: Clip microphone holder for the right-hand manual.*

If we are able to make such an L-shaped piece of metal merged with a pin of the size of pins that hold the bellows on the accordion, the pin must be the exact same size, we can replace the middle pin on the front side of the right-hand manual with this holder, if possible. I have tried it myself and it works great. However, I admit that this solution might not be for everyone since the holder can be quite tricky to make, and not all accordions have such pins that hold the three parts, right-hand manual, bellows and left-hand manual, of the accordion together.

Regarding the left-hand manual, in general, the best and most powerful sound comes from the left side, the side with the bass strap, but again, this must be tried out for every instrument. If we have more than one microphone for a manual, it is necessary to set them to the same distance apart. My subjective view is that it is better to have only one microphone for each manual, exceptionally two for the right one, because then it is better to adjust two or three output signals than four or five. We could use a splitter, but most of the splitter systems do not provide the ability to adjust the sound of the right hand and the left hand separately, which is crucial for most performers. The microphones must not interfere with hand movements. Since most microphone models are not made for the accordion, the issue of the microphone holder must be solved in some way. The design of some microphones offers an ability to mount a microphone on the bellows, but this is not a good solution of this problem, because when playing the bellows shake and ricochet technique, it can cause a big blow by blowing the air against the microphone diaphragm and the sound will be totally distorted. We also need to use wires and connectors carefully because they can be damaged during the performance as the player moves. However, there are about three ways to solve the problem of fixing the left-hand microphone onto the accordion.

The first solution is to use a gaffer tape since gaffer tape does not leave any sticky residue – we can place a rather small, flat piece of metal and stick it onto the top of the left-hand manual using the tape. This piece should extend over the edge of the accordion in the direction of the bellows. Then we can place a clip microphone onto the piece and direct it towards the loudest sound holes on our left-hand manual. However, I do not personally like this solution so much due to its unreliability and non-professional look. Again, the second solution is a use of some of the commercial holders that we can mount on the accordion. But I do not like this solution either because we are usually forced to use either glue or screw that we need to bolt into our instruments, which is always an irreversible step. Thus, I came up with my original solution within my research. With a little skill, we can make such a hooked piece of metal with a hole at one end (*Figure 5*).



*Figure 5: Clip microphone holder for the left-hand manual.*

Such a holder is threaded on the screw of the bass strap (the absolute majority of accordions has such a screw) and bolt back to the nut (*Figures 6-10*).



*Figure 6: Adjustable accordion bass strap.*



*Figure 7: Common screw system.*



*Figure 8: The clip microphone holder on the screw.*

This way we get a totally solid holder for the clip microphone meanwhile we are not forced to bolt anything to the wood of the instrument. This solution is very convenient, and we can put the holder on and off anytime we want. I have been using it myself and it works great.



*Figure 9: The bass strap fixed to the nut with the microphone holder attached.*



*Figure 10: Clip microphone attached to the holder.*

In case we do not want to bother with any cables, it is also possible to purchase a wireless system, any microphone that can be put into a radio signal transmitter.

Microphone on a clip is a very important type of microphone for amplifying of the left-hand manual, which is still in motion, and if we want to have a balanced sound of two manuals, we should use this type of microphone.

Using this solution both for the right and left hand, the sound is natural and still very defined. If there are other instruments playing, there is a little chance that their sound will be unintentionally captured. However, with a proper placement of the players and the apparatus on the stage, this may not be the case. It is possible to experiment with the accordion sound and to change the timbre of the instrument by various electronic effects, but in case of extreme signal processing, audio feedback can arise sometimes. Because the microphones are relatively close to the instrument, the accordion noises can also be transmitted from keystrokes, etc. It is believed that the disadvantage of this microphone type is that the contact microphones, due to their dimensions, cannot be wide membrane and therefore are not able to fully capture the lower frequencies. But this is questionable. For example, the Audio-Technica ATM350 microphone has a well-emphasized lower frequency band and we will have a very strong bass timbre at the output.

The contact microphones on clips and microphones built into the instrument allow the performer to move on the stage and easily change the position of the instrument.

#### 4.6 Microphones on stands

The microphones I have chosen to present here is: Shure SM57 (SM58), Sennheiser MKH 40P48, Shure SM81, Shure SM137, Shure Beta 57, Rode NT1-A, Rode M5, Neumann U87, AKG C214.

Preferably, two microphones, in some cases, multiple or even one may be used, are located within such a range from the instrument so that the full range of the instrument can be picked up. However, we should pay much more attention to amplifying of the left hand, which is constantly on the move. The microphone should be positioned so that it does not interfere with the movements of the performer's hand and the movements of the instrument, and at the same time, it should capture the sound of the bass part, pointing the microphone to the left, in the best way possible. From my own experience, I know that this is quite a task for someone who does not have any experience with amplifying of the accordion. The volume and tone quality of both closed and open bellows must be the same, which is difficult to achieve, and requires the use of a high-quality microphone that is sensitive to relatively long distances. At some situations, I would even recommend that the performer, when using this type of microphones, to place the microphone closer to the instrument and turn the bellows more often to achieve a balanced sound. On the other hand, this is not an ideal solution because turning bellows differently and more often does very often break performer's usual bellow phrases and make it very uncomfortable.

The choice of this solution allows a use of large-diaphragm condenser microphones which pick up better the lower part of the spectrum. But in "open-air" performances, the sound can be badly damaged by windy weather. In other words, we can afford to use even single large-diaphragm condenser microphone to record the whole instrument, but only in studio or indoor conditions. On contrary, a relatively large distance of the microphones from the accordion will also positively affect the transmitted keystrokes, rattling of the bellows and alike noise – they will be less hearable, but we must know the sensitivity and frequency characteristics of the particular microphone. Another advantage of this solution is that the timbre of the accordion will be most naturally room-coloured. On top of that, there is no need to deal with the problem of assembling, brackets and additional holders; the instrument will remain untouched.

As I mentioned before, among the disadvantages of this system is the difficulty of amplifying of the instrument, especially the left hand, when playing with other instruments that are present around the accordion or when the volume of other instruments is much greater than the accordion. In this case, it is difficult to avoid the situation when the sound of other instruments will be picked up by the accordion microphones. In the worst case, there will be more instruments in one signal. Then it is hard to separate and adjust the sound of the accordion itself. An audio feedback may also be apparent there. The problems of choosing the right microphone, placing of players on the stage, and directing of the microphones correctly must be solved. For example, when playing the accordion with a drum set in a small room, it is very difficult to achieve a good sound quality of the accordion. This solution will also limit the performer's mobility to move freely on the stage, the player will be fixed on a spot, more or less, and cannot walk, which might be a problem especially at certain live concerts of more popular genres. Overall, this is probably the best solution for solo players who want to achieve the most natural sound.

Naturally, it is possible to combine all the types of microphones and solutions. In my opinion, the most commonly used and most likely the most effective solution is using a contact microphone on a clip for the left hand, meanwhile the right manual is picked up by a quality microphone on a stand.

## 4.7 Overview of some specific microphones

In the following section, I will only mention the microphones that I have a personal experience with or with those I came across with at my concerts and worked with. I would personally suggest any of the listed microphones in some way. Individual microphones can be used in different situations and solutions for amplifying and recording of the accordion. For each of these microphones, I also state my opinion whether they are more suitable for live music or studio recording in connection with the accordion.

**Shure SM57 (SM58):** Microphone Type: Dynamic microphone on a stand.

The Shure SM57 is a microphone that is most likely to be found in most of sound engineer's gear and studios for amplifying instruments around the world. For its versatility, it is very popular especially for live amplifying. The overall construction of the microphone is all metal and very durable, it has cardioid directional characteristics. *The SM57 has an extremely effective cardioid pickup pattern that isolates the main sound source while minimizing background noise*<sup>7</sup>. When using this microphone, we can talk about quality audio transferring of the picked-up instrument if there are other instruments on the stage that are above the dynamic range of the accordion in terms of volume. I cannot say that the sound is transmitted in all details (due to the dynamic design of the microphone) though. Sound of the accordion, in terms of frequency characteristics, needs equalization adjustments, mids are usually too much, and sometimes high frequencies as well.

The appropriate microphone distance from the accordion is 10-20 cm for the right manual, 15-25 cm for the left manual. For the left hand, we should slightly turn the head of the microphone to the left-hand side from the accordion.

The Shure SM58 has almost the same design, but it will pick up instruments worse in terms of distance and low frequency response, because it is designed for singing.

- Suitable for: live music

**Shure Beta 57:** Microphone Type: Dynamic microphone on a stand.

The Shure Beta57 microphone is basically a more modern and more expensive version of the Shure SM57 microphone. It has a narrower directional characteristic, and it captures the accordion sound in a better and more natural way.

However, the sound of the right manual is a little too aggressive, especially when using the four-foot register. The sound of the bass manual is transmitted in a quite natural form, occasionally it may sound too midrange.

- Suitable for: live music

**Shure PG57:** Microphone Type: Dynamic microphone on a stand.

I would advise to direct the microphone to the middle of the right manual in a distance of 5-20 cm.

- Suitable for: live music

**Shure PG81:** Microphone Type: Condenser microphone on a stand.

This microphone has a clear piercing tone, even over the entire frequency range. I recommend pointing the microphone to the middle of the manual in a distance of 3-20 cm.

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<sup>7</sup> Shure SM57. *Www.shure.com* [online]. [quoted 2018-02-09]. Available from: <http://www.shure.com/americas/products/microphones/sm/sm57-instrument-microphone>

- Suitable for: live music and studio recording

**Shure MX185:** Microphone Type: Condenser microphone on a clip.

This microphone is designed for vocal and spoken word but, in my opinion, it is suitable for capturing of the right hand of the accordion as well. It captures the entire range of the disk part, the sound is very piercing at higher frequencies, but it is not very distinctive at lower frequencies. It can be used as a clip mic for the right hand.

- Suitable for: live music

**Shure 520DX:** Microphone Type: Condenser microphone on a stand.

A microphone developed specially for harmonica ('blowing harmonica'), it is not suitable for the transmission of the accordion sound. I name it here only as a matter of interest.

**Audio-Technica ATM350:** Microphone Type: Condenser microphone on a clip.

The Audio-Technica ATM350 is a high-quality microphone that captures the full range of a big concert accordion. In use, the output sound will be slightly coloured, the basses will be a little bit emphasised, and the higher mids will be missing (but this is partly caused by the placing of the microphone very close to the instrument). It is probably one of the best microphones for amplifying of the left hand, it has very strong and powerful basses. I use this microphone myself a lot and it does a great job at live concerts, however when recording in a studio, if we want to achieve a really natural timbre of the left hand-manual, we need to use this microphone together with another microphone (on a stand ideally) in order to cover the whole frequency spectrum properly. Because as I said, the ATM350 tends to cut the higher frequencies. I will talk more about this microphone further in the text.

- Suitable for: live music and studio recording

**DPA d:vote4099:** Microphone Type: Condenser microphone on a clip.

Microphone DPA d: vote 4099 is considered to be one of the best instrumental microphones. Its frequency range generally corresponds to the frequency range of the human ear. The output sound is very natural and balanced. One microphone is enough to sound the whole manual. This microphone was used for amplifying of the accordion and bandoneon of probably the greatest living accordionist Richard Galliano in the concert program "The Drama of Tango"<sup>8</sup>.

The sound engineer of Galliano's tour, Rémi Bourcereau, says: "I first used DPA microphones a year ago on a different tour and was delighted with the results they gave me," Bourcereau explains. "For this tour, we wanted the audience to feel as acoustically close to the instruments as possible and that is why I chose DPA. In close miking conditions they deliver a very natural sound, which is exactly what this type of music requires."

In my opinion, we cannot go wrong using the DPA d: vote 4099 microphone in most of situations. It will serve great for both live playing and studio recording but like in the case of the Audio-Technica ATM350, I would advice to use it together with microphones on stands for more natural sound when recording in a studio.

- Suitable for: live music and studio recording

**Beyerdynamic OPUS 86:** Microphone Type: Condenser microphone on a clip.

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<sup>8</sup> DPA Captures The Drama Of The Tango. *Www.mixonline.com* [online]. [quoted 2018-02-10]. Available from: <https://www.mixonline.com/the-wire/dpa-captures-drama-tango-415954>

“The Opus 86 has been developed for miking accordions and Styrian harmonicas. This cardioid condenser microphone features a true, detailed reproduction and high-gain-before feedback. The microphone is insensitive to handling noise and vibration from the instrument due to a special shock mount”.<sup>9</sup>

The microphone is mounted on the accordion with self-adhesive holders, which then remain on the instrument. The best sound is captured by using three microphones, two for the right manual, one for the bass manual, but if the instrument is not large, two microphones can be enough. In my opinion, this is a decent semi-professional clip microphone but does not reach the qualities of the Audio-Technica ATM350 or the DPA d: vote 4099.

- Suitable for: live music

**AKG C516ML:** Microphone Type: Condenser microphone on a clip.

AKG C516ML is a decent quality and quite popular microphone among accordionists. For complete amplifying of a bigger concert instrument, it is best to use three microphones. Eventually, we could use it only for miking of the left hand. AKG delivers original mounting plates that can be fixed onto the instrument by screws, the plates will remain on the instrument. Sound of the bass manual will sound too midrange, lower frequencies will be missing. In my opinion, AKG C516ML represents a basic solution on budget for amplifying of the accordion. If we look for a better accordion microphone on a clip, I would suggest rather the DPA d:vote4099 or the Audio-Technica ATM350, especially for a concert instrument.

- Suitable for: live music and studio recording

**Rode NT1-A:** Microphone Type: Condenser microphone on a stand.

Since this microphone is extremely popular among musicians around the world, it is not rare to see it also in equipment of many accordionists. I have used it many times as well, and it can serve as a good option for a microphone on a stand, especially for the right hand. However, this microphone sounds a bit too aggressive in high mids, and when placed too close to the right-hand manual, it captures quite a lot of mechanical noise. It is a very good microphone for the price, but it does not reach the quality of more expensive large diaphragm condenser microphones where the sound is more detailed and ‘real’. After all, it is still rather a vocal microphone.

- Suitable for: live music and studio recording

**Rode M5 (matched pair):** Microphone Type: Condenser microphone on a stand.

As other microphones by the Rode Company, the Rode M5 stereo pair represents a decent and complex solution for stereo recording and amplifying of an instrument for a good price. After testing this microphone, I would not recommend it as a complete solution for studio recording of the accordion if we were after a warm sound with emphasized basses. Its frequency response is quite weak in lows but, it may work much better in combination with a clip microphone for the left hand which will support the sound with richer basses. I use this mic quite often for the right hand though, mainly for its decent tolerance to mechanical noises of the buttons.

- Suitable for: live music and studio recording

**AKG C214:** Microphone Type: Condenser microphone on a stand

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<sup>9</sup> Beyerdynamic OPUS 86 User’s Manual, Specifications and graphs

The AKG C214 is a great professional large diaphragm microphone for recording of the accordion due to its rather flat frequency response and detailed sound. It excels especially as a stereo pair – one microphone for each hand. It has almost identical sound as AKG C414, which is perceived as one of the industry standard microphones in the world (the C214 and C414 should have the same capsule). The only difference is that the C214 has only a cardioid polar pattern, which, however, is entirely enough for needs of an accordionist.

- Suitable for: live music and studio recording

In conclusion of this overview, I would like to mention two microphones of the Neumann Company. It is **Neumann U87 Ai** and **Neumann KM 184**, a pair ideally. Both these professional condenser microphones are a great option for capturing of the accordion, especially in a studio. And there are other great professional microphones suitable for recording of this instrument (AKG C414 XLS, Rode NTR, etc.) If we have an opportunity to use either of these ones, or any other alike microphone in this category, we can never go wrong. In such cases, more than on the microphones, it always depends more on the acoustics of the particular place, other parts of the sound string (amplifier, mixer, etc.), skills of the sound engineer, placing of the microphones, and last but not least, the actual performer.

## 5 Processing of the accordion sound

The sound of the accordion is captured by the microphone(s) and can be transferred to loudspeakers without any additional correction (which is a quite extraordinary case), or more often can be processed and modified in some way. If the accordion sounds well in the room and the microphones are only used to make a slight increase of the volume level, it is often good to mix the sound from the speakers with the acoustic sound of the instrument to maintain the natural timbre as much as possible. Another important thing is to adjust the volume ratio between the left and right manual. The bass manual must not exceed the right manual at the output (unless it is an intention of the player). However, the input signal level may be higher due to occasional increasing of the distance between the microphone and the bass manual (does not apply to microphones on a clip).

### 5.1 Equalization

Even when we use high-quality microphones and equally good equipment, we can quite often find out that the sound at the output differs from the acoustic sound or from our intention. Thus, the equalization, in other words, adjusting of its frequency running, is a very important part of sound processing. Using a special device (equalizer), we can freely boost or cut highs, mids and lows of the instrument, and with more sophisticated devices even concrete parts of the audio spectrum. In concert practice, a common graphic equalizer is used. *In the graphic equalizer, the input signal is sent to a bank of filters. Each filter passes the portion of the signal present in its own frequency range or band.*<sup>10</sup> This makes it possible to set the frequency of the entire audible spectrum very well. An equalizer is commonly fitted with slide potentiometers. *The amplitude passed by each filter is adjusted using a slide control to boost or cut frequency components passed by that filter. The vertical position of each slider thus indicates the gain applied at that frequency band, so that the knobs resemble a graph of the equalizer's response plotted versus frequency.*<sup>11</sup> This allows us a clear and quick

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<sup>10</sup> Equalization (audio). In: *Wikipedia: the free encyclopedia* [online]. San Francisco (CA): Wikimedia Foundation, 2001- [quoted 2018-02-12]. Available from: [https://en.wikipedia.org/wiki/Equalization\\_\(audio\)#Graphic\\_equalizer](https://en.wikipedia.org/wiki/Equalization_(audio)#Graphic_equalizer)

<sup>11</sup> Equalization (audio). In: *Wikipedia: the free encyclopedia* [online]. San Francisco (CA): Wikimedia Foundation, 2001- [quoted 2018-02-12]. Available from: [https://en.wikipedia.org/wiki/Equalization\\_\(audio\)#Graphic\\_equalizer](https://en.wikipedia.org/wiki/Equalization_(audio)#Graphic_equalizer)

orientation when setting up our desired sound. The number of frequency channels depends on the space between the filters. *An equalizer for professional live sound reinforcement typically has some 25 to 31 bands, for more precise control of feedback problems and equalization of room modes.*<sup>12</sup> An equalizer is a part of a mixing console (there are only three potentiometers on simpler devices – for basses, mids and highs) and such an equalizer is sufficient for fundamental sound adjustments. When amplifying the accordion, it often happens that the signal of some microphones is too sharp and centre, so it is good to slightly cut the mid and higher frequency band. And on the other hand, we can boost the lower frequencies of the bass manual a little bit. But overall, the equalization adjustment will certainly vary for every particular instrument, microphone, speaker, and room. It is important to note that when correcting the output sound, first, we need to cut the frequencies and if we do not achieve the desired result, then boost the frequencies. Generally speaking, for the best accordion sound, we should aim for rather a warm, polished and soft character of sound, because this instrument often tends to sound a little bit harsh and aggressive and with a lot of mechanical noise from the buttons when approached wrong. And in such case, we can adjust particular frequencies not only in a common EQ but also in an EQ of a reverb effect for example.

## 5.2 Compressor / Limiter

Compressor and Limiter are processors for dynamic signal adjustment. *Compressor is a device that reduces the volume of loud sounds or amplifies quiet sounds thus reducing or compressing an audio signal's dynamic range.*<sup>13</sup> In other words, a compressor can reduce the difference between the quietest and the loudest sound in the signal. Dynamic compression is necessary when mixing and mastering a recording because it is often needed due to the environment in which we listen to the recording. When listening to music while driving a car or in some other noisy environment, in a broad dynamic range, all quiet passages can be lost in the surrounding noises. By equalizing those soft passages to a higher dynamic level, we make even highly dynamic music listenable in such noisy environments. At the same time, thanks to the possibility of controlling of the dynamics, we can avoid over boosting of the outcome sound. At concerts, the accordion dynamics compression may be suitable for use in rock and pop music because the accordion has a larger dynamic range than other instruments, the accordion sound sometimes disappears at quieter passages and at the strongest ones, on contrary, is over boosted. Of course, we should use only a very little or no engagement of these two processors for classical music.

### 5.2.1 Parameters of the compressor/limiter

Most compressors derive dynamic control from a certain adjustable point, threshold of sensitivity - THRESHOLD. Up to this threshold level, which is set by the user at will, the signal passing through the device is unaffected. After exceeding the threshold level, the signal level is reduced. And it depends on the settings of other individual parameters how fast and how much of the signal reduction we get. I will not specify any concrete ratios and parameters of the compressor and limiter since it very much depends on music genre, quality and character of the recording, artist's intentions, etc.

## 5.3 Reverberation effect - reverb

Effects processors making an artificial reverb are nowadays an essential part of every recording studio and gear for live amplifying. Modern technology makes it possible to produce devices that can faithfully simulate reverberation of real concert halls, clubs, churches, big studios, but also everyday

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<sup>12</sup> Equalization (audio). In: *Wikipedia: the free encyclopedia* [online]. San Francisco (CA): Wikimedia Foundation, 2001- [quoted 2018-02-12]. Available from: [https://en.wikipedia.org/wiki/Equalization\\_\(audio\)#Graphic\\_equalizer](https://en.wikipedia.org/wiki/Equalization_(audio)#Graphic_equalizer)

<sup>13</sup> Dynamic range compression. In: *Wikipedia: the free encyclopedia* [online]. San Francisco (CA): Wikimedia Foundation, 2001- [quoted 2018-02-13]. Available from: [https://en.wikipedia.org/wiki/Dynamic\\_range\\_compression](https://en.wikipedia.org/wiki/Dynamic_range_compression)

environments (living room, office, etc.). In some rooms, the accordion sounds too dry and strident. To make the sound of the instrument broader in volume and strength, reverberation effects are necessary. When recording the accordion in a dry studio with absorbers around, the raw sound captured in such a studio should be enriched by a digital reverb in most cases. The amount of the reverb is usually a matter of taste and depends only on the character and genre of the music.

#### 5.4 Basic reverberation parameters

DECAY TIME - reverberation time, this is the time for which the reverberation fades out.

PRE-DELAY - the initial delay, it is the time that elapses between we hear the direct sound and its first reflection.

On some reverb processors, the parameter which defines the ROOM SIZE is also available. In most cases, it is possible to simultaneously control several reverberation parameters that are directly related to the room dimensions, which saves time when setting it. Several reverberation algorithms are available on most models, based on a specific pattern of reflections for each environment. We can come across these ones most often:

HALL (concert hall) - the reverberation is alike a reverberation in large concert halls.

ROOM, CHAMBER (room) - shorter reverberation typical for medium and smaller rooms.

AMBIANCE - reverberation is a tight part of the sound, a very short decay.

PLATE - a group of reflections typical of metal reverberation plates.

REVERSE - inverse dynamic reverberation (increase instead of drop)

Practically, the most important reverberation parameter is the reverberation level, resp. the ratio of direct sound to reverberation. In a common environment, ratio between the direct sound and reverberation is determined by the distance of the microphone from the sound source and is influenced not only by the acoustics of the room but also by the polar pattern of the microphone. To simplify it, the closer we put the microphone to the source of the sound the less reverb we get.

#### 5.5 Delay

Delay is an effect of time delay of the signal. The signal is repeated with a delay. The dynamics of each repetition can gradually decrease. We can set the presence and intensity of the FEEDBACK (if feedback is not set, the signal will have only one repeat), DELAY TIME - the time between the original signal and its repetition, and the ratio between the original and delayed signals.

The most common effects that use the delay principle are ECHO, CHORUS, VIBRATO, PHASING and FLANGING.

#### 5.6 Looper and Sampler

One of the most popular effects of all musicians. A relatively short musical section is recorded and repeated over and over. The number of patterns being played depends on a particular loop model, but it can be multiple usually.

## 6 Recording of the accordion in a studio - the specifics of recording of the accordion

**The following points are based on my personal experience:**

- Both musician and sound engineer must have a precise and concrete idea of what final sound they would like to reach.
- Choice of space. An important part is the acoustic properties of the room we record in. It is necessary to examine the room in terms of reverberation and also in terms of the instrument's frequency spectrum (in some rooms the bass tones often lose (or boost) their low frequencies). It should be remembered that when using different equalizers and other correction devices (or plugins eventually), it is always better to cut some of the frequencies than to boost, otherwise the sound can be very unnatural.
- In my opinion, every recording should consist of 'detail, whole and background' when recording in lively acoustics. I could compare it to paintings. There are close, sharp objects on a painting, but also blurry background. The same applies to sound, we should be able to hear both close, direct sound of the instrument and its more distant room sound on the recording.
- Microphones. The accordion should be recorded with two or more microphones (the left and right-hand manual) and room microphones if possible or needed. For the bass manual, it is advisable to use a large diaphragm microphone (but it is not necessary) and direct it to the left side of the accordion so it does not interfere with the musician's left hand. Even a better way to capture the moving left-hand manual is to use a quality contact microphone on a clip together with a microphone on a stand, the volume level of the basses will not drop at all then. The distance of the microphones from the instrument is determined depending on the idea of the final sound. However, it should be remembered that by shortening the distance between the microphone and the instrument, there will be more mechanical noise in the signal (knocking of the buttons and keys, rustling of the bellows), which in some cases may be even appealing for someone.
- In connection with the music style and the creative goal, it is sometimes even good to record the left and right hand separately. Then it is much easier to adjust and correct each part independently. But this case is still quite rare.
- In general, when recording and mixing stereo sound, it is better to pan the accordion so that the right and left manual are panned to the right and to the left in the same proportions, because accordion pieces do not favor one manual more than the other. This does not apply to the 'one clip mic & one stand mic' solution because the clip microphone always separates the distant sounds so that the other manual is barely hearable. Hence, in that case we should pan the clip microphone a bit less in order to maintain the overall balance.
- When doing EQ adjustments, it is advisable to slightly boost and emphasize the bass frequencies.
- When recording together with other instruments, we need to be careful about tuning the instruments and test it beforehand properly.

### 6.1 Techniques of Stereo Recording for the accordion

If we intend to use two microphones to record the accordion, we should be aware of several aspects of stereo recording. I would like to list and discuss two most common techniques that are suitable for recording of the accordion. These are A/B and X/Y techniques. They are very traditional and widely used, and can be good enough for the accordion as well, however, they work best in rooms with good and balanced acoustics.

### 6.1.1 A/B technique

I personally consider the A/B technique to be the most suitable for recording of the accordion. Two condenser microphones stand about 40 centimetres in front of the instrument (the ideal range is from 20 to 200 cm of distance from the accordion; 20 – 50 cm for dry studio acoustics, 40 – 200 cm for lively room acoustics), when each of the microphones is directed towards one manual. It gives a very wide stereo image, and a good separation of particular manuals, which we can work with in post-production, but still with a natural leakage of the other manual. The ratio of panning of the channels might be either 100L/100R or less (usually it varies from 90L/90R to 30L/30R because we do not want the instrument to sound too separated), depending on the distance between the microphones and their leakage. This technique is suitable both for recording in dry studio acoustics and rooms with rich natural reverb.

- **Sound sample no. 1** – AKG C214 – leakage test. In this sample we can hear the difference between three different microphone positions – 20 cm from the right-hand manual, 50 cm in front of the bellows, 20 cm from the left-hand manual. The difference between the ratios of leakage is enormous. As I have said before, we should view the accordion as two instruments in terms of sound. There is not probably any other instrument that would have two equal sources of sound this separated. The accordion is quite unique in this. Thus, the question of leakage is crucial here. If we want to get a natural stereo image of the instrument, we should not place the microphones too far away from each other, and if so, we should even out the balance by panning the channels – not 100L/100R but 60L/60R for example.

For comparison, I give some examples of the A/B method here:

- **Sound sample no. 2** – AKG C214 stereo pair – close A B technique, 100L/100R. The microphones are spaced about 50 cm between each other and 25 cm from the accordion. Each of the microphones picks up one manual primarily. At this sample, we can hear how separated the manuals may sound if we pan the channels all the way to the sides.
- **Sound sample no. 3** – AKG C214 stereo pair – close A B technique, 50L/50R. This is the exact same recording as shown on the *Sound sample no. 2*, but the channels are panned closer to each other for a more natural stereo effect. This method gives us a very live and wide stereo image and on top of that, we can easily work with dynamics of the manuals separately if needed.
- **Sound sample no. 4** – AKG C214 stereo pair – distant A B technique, 100L/100R. The microphones stand 200 cm from the instrument. We can afford to pan them all the way to the left and right because the sounds of individual manuals merge with bigger distance from the accordion. We still reach a fairly good stereo image; however, we get more room sound, which is not so obvious here because this sample has been recorded in a room with dry acoustics.

### 6.1.2 X/Y technique

The X/B techniques is another stereo method that we can use. It gives a more unified stereo image than the A/B technique. The microphones stand as close as possible to each other (crossed), each microphone directed towards one manual. I would suggest using this method rather in situations where our intention is to capture a natural sound of the accordion in a room with lively acoustics. In this case, the panning ratio is always 100L/100R.

- **Sound sample no. 5** – AKG C214 stereo pair – close X Y technique, 100L/100R. The microphones stay in front of the accordion in the distance of 30 cm. This method gives a very narrow and compact stereo image.
- **Sound sample no. 6** – AKG C214 stereo pair – distant X Y technique, 100L/100R. The microphones stand 100 cm from the instrument. Again, we get more room sound by placing

the microphones further from the instrument. However, in a studio with dry acoustics, this method this far away from the accordion does not make so much sense since the sound is not so defined, and we do not get the opportunity to work with the sound of particular manuals.

#### 6.1.2.1 *A/B versus X/Y*

The difference between the A/B or X/Y technique in sound character might not be so obvious in a studio with dry acoustics, however the difference is very substantial in rooms and halls with rich lively acoustics. In such rooms with echo, when using the A/B technique, the bigger distance is between the microphones the wider stereo image we get since the reflections arrive to one microphone slightly earlier or later than to another one, which makes this wide stereo effect. Using the X/Y technique, we get a much narrower image since the reflections arrive to the microphones in the relatively same time.

- **Sound sample no. 7** – Rode M5 stereo pair – A/B technique, 100L/100R, lively acoustics. The microphones are spaced 50 cm between each other and placed 100 cm from the instrument.
- **Sound sample no. 8** – Rode M5 stereo pair – X/Y technique, 100L/100R, lively acoustics. The microphones are placed 100 cm from the instrument.
- **Sound sample no. 9** – Rode M5 stereo pair – A/B technique, 100L/100R, lively acoustics. The microphones are spaced 50 cm between each other and placed 200 cm from the instrument.
- **Sound sample no. 10** – Rode M5 stereo pair – X/Y technique, 100L/100R, lively acoustics. The microphones are placed 200 cm from the instrument.

#### 6.1.3 Combined techniques

Of course, we can combine different methods in multichannel recording. It might be a combination of the A/B and X/Y technique when the A/B is closer to the instrument meanwhile the X/Y serves more like a room microphone, we can combine either of these methods with clip microphones attached to the instrument, or it can be a variation of different solutions and multiple microphones depending on our intention and possibilities. There is also a possibility of using the ORTF technique which works out well for the accordion as well. It should be always borne in mind that with larger number of microphones, the risk of appearance of phasing and flanging effect rises.

When we use clip microphones or place the microphones very close to the manuals, we also get more freedom for automation of particular manuals.

If we have no other option and are forced to use only one microphone to record the accordion, or if we intend to use one middle microphone as an addition to another ‘manual focused’ microphones, I suggest placing it in front of the bellows (the middle of the instrument), the distance from the instrument can vary from 30 up to 100 cm, depending on the room acoustics and other present instruments if there are any.

- **Sound sample no. 11** – AKG C214 – one microphone, distance test. The microphone is gradually placed 20 cm, 30 cm, 100 cm and 150 cm from the accordion. At the 20 cm distance, the microphone is too close to capture the full frequency spectrum of the left-hand manual, therefore the right hand dominates here. At the 150 cm distance, the sound is too distant and less detailed. Hence, the most usable one microphone distance varies from 30 to 100 cm from the instrument, unless we do not plan to use it as a room microphone in lively acoustics to capture the reverb of the room.

## 6.2 Left-hand manual miking

The right approach of capturing of the left-hand manual is a separate and special chapter due to its specifics. The accordion is a harmonic instrument with enormous stereo capabilities, and as I have mentioned before, we could perceive the two accordion manuals as two separate instruments. Before I specify individual solutions for the left-hand miking, I would like to discuss an effect that I have

discovered within this research and which could cause serious problems in final sound. This effect is called FLANGING.

*Flanging is an audio effect produced by mixing two identical signals together, one signal delayed by a small and gradually changing period, usually smaller than 20 milliseconds. This produces a swept comb filter effect: peaks and notches are produced in the resulting frequency spectrum, related to each other in a linear harmonic series. Varying the time delay causes these to sweep up and down the frequency spectrum.*<sup>14</sup>

Flanging may occur when we use multiple microphones placed apart from each other, each focused on a separate manual, but with a lot of leakage of the other manual at the same time. This is caused by the constant move of the left-hand manual, it is basically a moving source of sound that we need to deal with and it may make troubles in the stereo sound. Especially when we use one microphone on a clip for the left hand and one microphone on a stand also directed to the left hand and placed too close to the manual. The time when the sound from the left-hand manual reaches the microphone on a stand changes because the left-hand manual moves all the time, meanwhile the clip microphone captures a consistent sound since it is fixed to the manual and moves along with it keeping the same distance from the source. Then these two tracks of the same sound but different phases crush between each other and make this unwanted effect. It can also appear when playing with another instrument and using only two microphones, one for the accordion and one for the other instrument. In such a case, there is a big leakage between the microphones and the same problem rises. If I should compare it, it is like recording two musicians (one channel for each) playing the same piece but one of the musicians would be walking around the place. However, I do not want to frighten you, this effect is usually present in such a small scale and only within certain recording solutions that we should not be afraid of it, but it is good to know about it and know how to avoid it.

Unintentional accordion flanging may sound like this:

- **Sound sample no. 12** – AKG C214 & Audio-Technica ATM350 – flanging test. The left-hand manual is being picked up by a clip microphone and a microphone on a stand at the same time. As you can hear, especially at the end of the track, the effect of flanging appears gradually as the manual moves further away from the microphone on a stand.

If we use such a solution or a solution of the same principal to pick up the left hand, we should place the microphone on a stand a little bit further away from the accordion, depending on the room and intended character. Because with increasing distance of that microphone from the left hand-manual, the variable wavelength becomes less and less important. Basically, if the microphone is only 20 cm away from the manual and then gets 40 cm away as the bellows move, the distance between the microphone and the manual will increase about 100%. Meanwhile, if the microphone is 200 cm away from the manual and then gets 220 cm away, the ratio increase will be only 10% which is insignificant.

Regarding the sound character and timbre of the left-hand manual, I would like to demonstrate the difference between a microphone on a stand and a microphone on a clip. I play the deepest possible tone on my concert accordion (E1) in these sound samples.

- **Sound sample no. 13** – AKG C214 – left-hand manual microphone test (*Figure 11*). Large diaphragm condenser microphone on a stand, 25 cm from the instrument. In my opinion, this

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<sup>14</sup> Flanging. In: *Wikipedia: the free encyclopedia* [online]. San Francisco (CA): Wikimedia Foundation, 2001- [quoted 2018-10-01]. Available from: [https://en.wikipedia.org/wiki/Flanging#Artificial\\_flanging](https://en.wikipedia.org/wiki/Flanging#Artificial_flanging)

professional microphone gives the most natural sound compared to the Rode M5 and Audio-Technica ATM350. It is rich in the lows and bright in the highs.



Figure 11: AKG C214 – left-hand manual microphone test.

- **Sound sample no. 14** – Rode M5 – left-hand manual microphone test (Figure 12). This ‘on a budget’ small diaphragm condenser microphone, standing 25 from the instrument, is not the ideal option for left hand miking due to its weak response in low frequencies. Also, it is not as detailed as the AKG C214.



Figure 12: Rode M5 – left-hand manual microphone test.

- **Sound sample no. 15** – Audio-Technica ATM350 – left-hand manual microphone test (Figure 13). Small diaphragm condenser microphone on a clip, 15 cm from the instrument. Clip microphones attached to the left-hand manual provides a great warm sound, which

accordionists aim for, with boosted lows. However, this solution is usually weak in reproduction of highs due to its specific placement - very close to the accordion chassis. Such a sound character may sound too artificial and unsatisfying in some music genres.



Figure 13: Audio-Technica ATM350 – left-hand manual microphone test.

In my opinion, the best solution for miking of the left hand is a combination of a clip microphone and a microphone on a stand. This solution gives very strong and defined bases but preserves the brightness and openness of the distant microphone.

- **Sound sample no. 16** – AKG C214 –left-hand manual microphone test. Large diaphragm condenser microphone on a stand, 25 cm from the instrument.
- **Sound sample no. 17** – Audio-Technica ATM350 – left-hand manual microphone test. Small diaphragm condenser microphone on a clip, 15 cm from the instrument.
- **Sound sample no. 18** – AKG C214 & Audio-Technica ATM350 – left-hand manual microphone test. This is what these two microphones sound like combined. Such a complex, warm, and natural sound is better than most of eventual artificial EQ adjustments when aiming for the natural accordion sound, in my opinion.

In some cases, a common microphone on a stand can be replaced or completed by a kick drum microphone to pick up the left hand. Kick drum or bass drum microphones are also a great option for left-hand manual miking thanks to their boost of lows.

We could also use a microphone with the omni pattern in a studio to capture basses evenly. We should place such a microphone quite close to the floor, and closer to the left-hand manual. The omni microphone may not be so prone to a change of sound character caused by changing the distance of the left-hand manual when moving the bellows.

### 6.3 Right-hand manual miking

It is not as tricky to pick up the right-hand manual right as the left-hand manual. This manual is steadier; therefore, a clip microphone is not needed for studio recording. We can use a good quality condenser microphone with cardioid characteristics (both large and small diaphragm are suitable), and

it is only about finding the right distance from the manual depending on how separated sound we want to get. The closer we put the microphone the less leakage of the left hand we will get which might be good for post-production, but with shorter distance increases the amount of mechanical noise – knocking of buttons or keys and sometimes even unwanted sounds made by reed leathers vibrating in certain frequencies (such sounds of vibrating leathers may evoke an effect of distortion). Advisable distance of the microphone from the right-hand manual is 10-100 cm.

For comparison, here I give examples of right-hand manual sound captured by three different microphones.

- **Sound sample no. 19** – AKG C214 – right-hand manual microphone test (*Figure 14*). Large diaphragm condenser microphone on a stand, 25 cm from the instrument. Again, this professional microphone gives the most natural and real sound compared to the other two microphones. As you can see on the graph, this microphone is very responsive in highs which gives a nice bright sound.

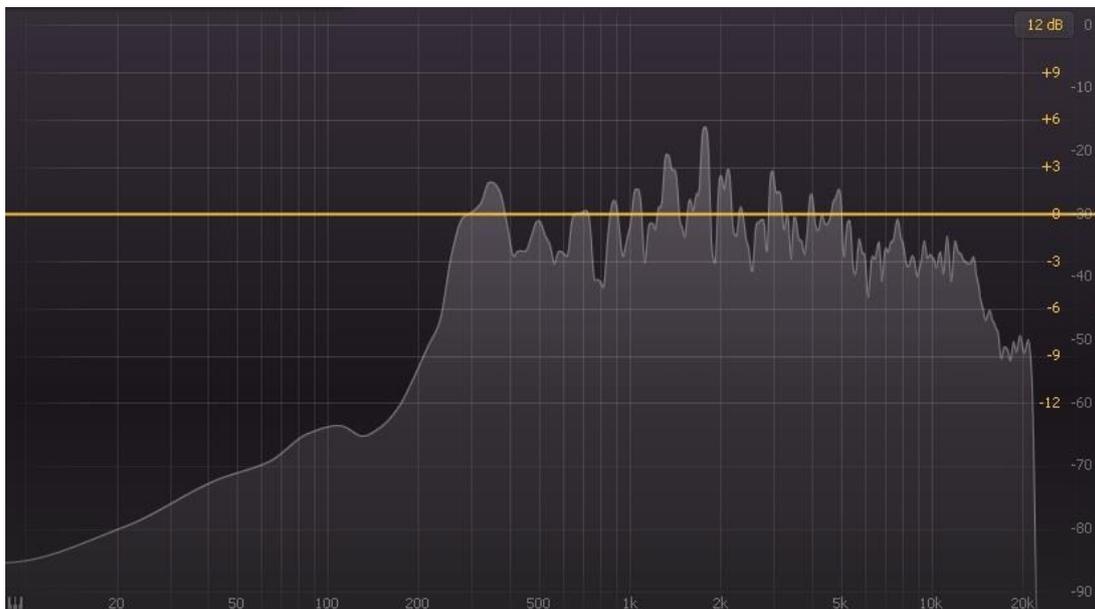


Figure 14: AKG C214 – right-hand manual microphone test.

- **Sound sample no. 20** – Rode M5 – right-hand manual microphone test (*Figure 15*). Small diaphragm condenser microphone on a stand, 25 cm from the instrument. This rather cheap microphone still gives a warm soft sound, but it sounds blurry and less detailed compared to the AKG C214.



Figure 15: Rode M5 – right-hand manual microphone test.

- **Sound sample no. 21** – Audio-Technica ATM350 – right-hand manual microphone test (Figure 16). Small diaphragm condenser microphone on a clip, 15 cm from the instrument. This microphone gives a very similar output sound to the Rode M5. However, due to its less bright highs, I would recommend this microphone rather for the left-hand miking.

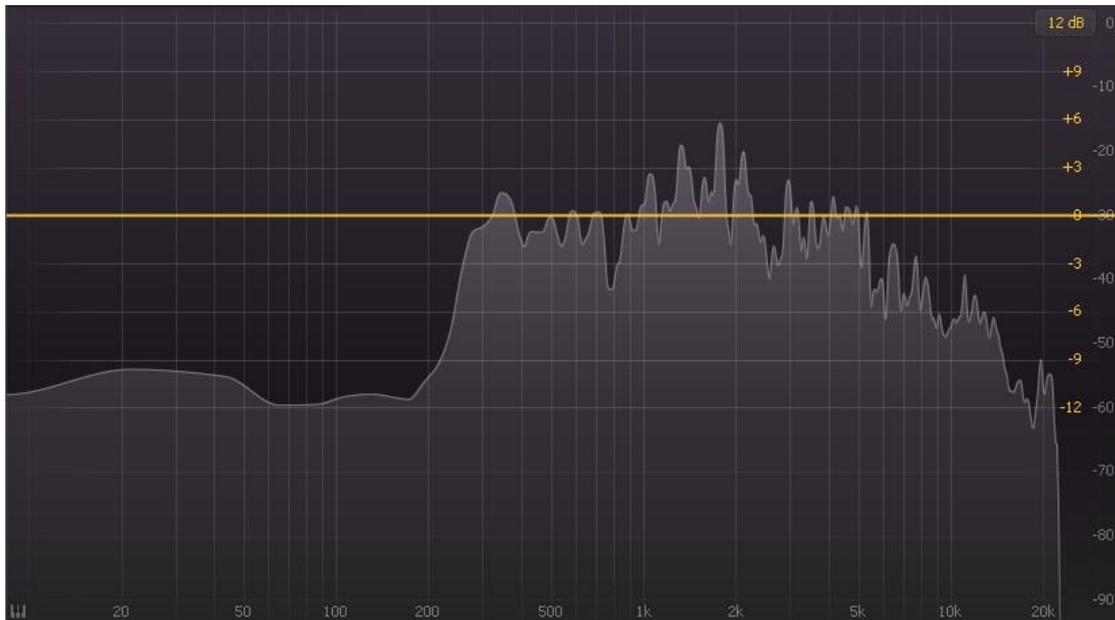


Figure 16: Audio-Technica ATM350 – right-hand manual microphone test.

If we decide to use a microphone on a clip for the right-hand manual, we must be sure that the microphone picks up the whole range of the manual, otherwise we should use two clip microphones.

- **Sound sample no. 22** – Audio-Technica ATM350 – clip microphone for the right-hand manual test. The example of sound balance of the right-hand manual using one microphone on a clip. In this sample, I play the whole range of the right-hand manual of my concert accordion

(G2 – C7) in even dynamics. You can hear that the dynamics of the output signal is fairly even, only with a slight volume decrease on the high tones, but these high tones are naturally a bit quieter.

#### 6.4 Acoustic properties of different parts of the accordion

I can clearly illustrate the need of stereo or multichannel recording solutions on following sound samples. If we want to capture a real picture of the accordion timbre and sound character, we should use multiple microphones placed the way they are able to capture the accordion as one complex instrument in terms of timbre and frequency characteristics. But still, in general, microphones should be placed preferably in front of the instrument since the accordion is designed to sound best from the front part (facing the audience). Hence, to close this chapter, I give several sound samples of the accordion picked up from different positions, and we can compare the differences in timbre. These samples were recorded in a frequency balanced room with minimum reflections. As a reference microphone, I use the professional condenser microphone AKG C214. I play an A major chord both in the right and left hand in all these samples.

- **Sound sample no. 23** – AKG C214 – the microphone is placed 40 cm in front of the accordion facing the bellows (*Figure 17*).



*Figure 17: AKG C214 – the microphone placed 40 cm in front of the accordion.*

- **Sound sample no. 24** – AKG C214 – the microphone is placed 50 cm in front of the right-hand manual (*Figure 18*).



Figure 18: AKG C214 – the microphone placed 50 cm in front of the right-hand manual.

- **Sound sample no. 25** – AKG C214 – the microphone is placed 50 cm from the instrument, on the side of my right hand, directed to the right-hand manual (*Figure 19*).



Figure 19: the microphone placed 50 cm from the instrument directed to the right-hand manual.

- **Sound sample no. 26** – AKG C214 – the microphone is placed 50 cm from the instrument, on the side of my left hand, directed to the left-hand manual (*Figure 20*).



Figure 20: AKG C214 – the microphone placed 50 cm from the instrument directed to the left-hand manual.

- **Sound sample no. 27** – AKG C214 – the microphone is placed 20 cm under the instrument, directed to the bottom of the bellows (*Figure 21*).



Figure 21: AKG C214 – the microphone placed 20 cm under the instrument.

- **Sound sample no. 28** – AKG C214 – the microphone is placed 30 cm behind the instrument, at the level of my head (*Figure 22*).



Figure 22: AKG C214 – the microphone placed 30 cm behind the instrument

- **Sound sample no. 29** – AKG C214 – the microphone is placed 40 cm behind the instrument, directed to the rear part of the left-hand manual (*Figure 23*).



Figure 23: AKG C214 – the microphone placed 40 cm behind the instrument.

- **Sound sample no. 30** – AKG C214 – the microphone is placed 50 cm above the instrument, directed to the upper part of the bellows (*Figure 24*).

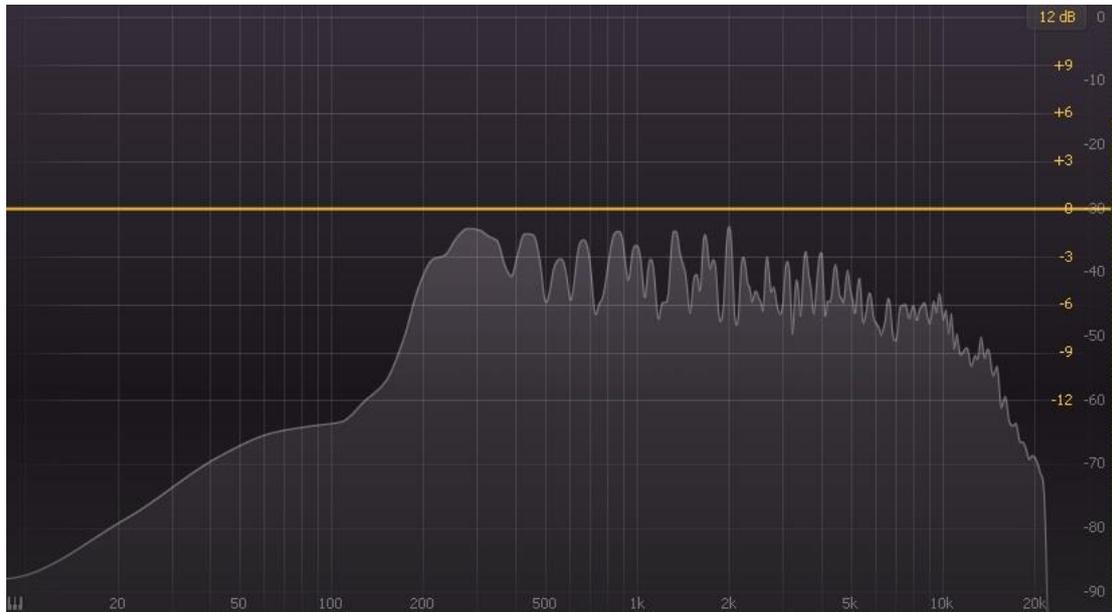


Figure 24: AKG C214 – the microphone placed 50 cm above the instrument.

## 7 Specific recording solutions

In this chapter, I would like to give several examples of concrete recording solutions for the accordion, which I personally tested and found suitable after this research. Of course, there is a substantial amount of possibilities to record the accordion; variety of different microphones, their placing and number, choice of the room, EQ adjustments, etc. The possibilities are endless, but these given examples represent the most common and safest ways to approach the recording of the accordion in my opinion, and they may serve as a starting point which we can build on depending on our creativity, intentions and possibilities.

### 7.1 Solo accordion

In my opinion, the most effective, easiest and most suitable way of recording of the accordion in a studio would be either usage of a stereo pair of microphones placed in front of the instrument, two separated microphones closely attached to the manuals of the instrument, or a combination of these two solutions. Of course, we can use an opportunity of using a lot of different microphones placed around the accordion if available, but two or four microphones will be enough for a representative sound in most cases. Following sound samples have been recorded in a studio with dry acoustics.

#### Solution no. 1

The A/B technique. Most likely the easiest recording solution (*Figure 25*).

- **Sound sample no. 31** – AKG C214 stereo pair – A B technique, 50L/50R. The microphones stand 25 cm in front of the accordion, 50 cm away from each other. This solution gives a very natural aerial sound and wide stereo image, very good for eventual adjustments in post-production. The panning of 50L/50R is quite extreme here when used in classical music. The panning could be even narrower in this case, but it is always the matter of taste.

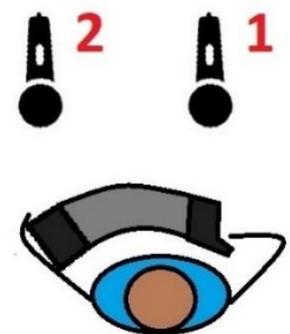


Figure 25

## Solution no. 2

Two clip microphones, one for each manual (the right-hand microphone can be substituted with a microphone on a stand) (*Figure 26*).

- **Sound sample no. 32** – Rode M5 (1) & Audio-Technica ATM350 (2) – 26L/21R. The microphone 1 (Rode M5) is directed to the right-hand manual, 20 cm from it. The microphone 2 (Audio-Technica ATM350) is attached to the left-hand manual, 15 cm from it. This solution gives the most separated sound of particular manuals with the lowest leakage possible, great for adjustments in post-production. However, the sound feels a little bit blurry and pent. On the other hand, this solution is not prone to sound changes caused by movements of the left hand.

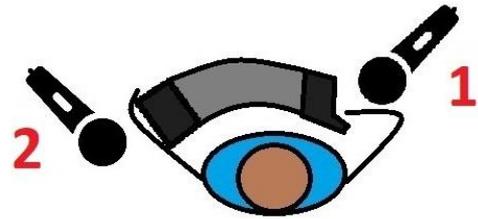


Figure 26

## Solution no. 3

The A/B technique (1,2) combined with two clip microphones (3,4) (*Figure 27*).

- **Sound sample no. 33** – AKG C214 stereo pair (1,2) & Rode M5 (3) & Audio-Technica ATM350 (4) – combined solution, 50L/50R & 26L & 21R. This is what happens when we mix the previous two solutions together. The pan ratios remain the same. It gives a very complex, natural and defined sound. In my opinion, this solution seems to be the best of 4 channel recording solutions, especially in dry acoustics like this one where we do not pick up the room sound. Of course, the output sound is too dry and needs further adjustments in post-production.

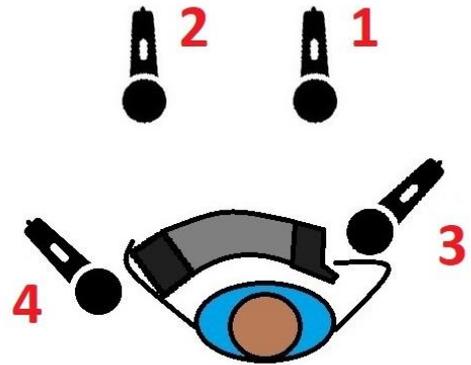


Figure 27

- **Sound sample no. 34** – AKG C214 stereo pair & Rode M5 & Audio-Technica ATM350 – combined solution, 50L/50R & 26L & 21R, REVERB. And this is what the recording from the previous sound sample sounds like when we add an artificial reverb on it. It is the exact same take as in the *sound sample no. 33*. Apart from the added reverb plugin, there are no EQ adjustments or other artificial plugins. It is one of my favorite recording solutions due to its clear and defined sound and possibility to freely work with the recording in post-production.

## Solution no. 4

One centre microphone on a stand (1) combined with two clip microphones (2,3) (*Figure 28*).

Two microphones on the sides give a close defined sound and allow further volume adjustments of individual

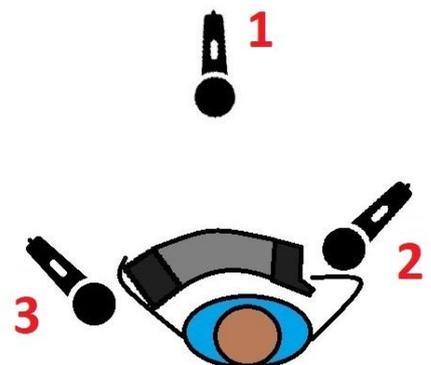


Figure 28

manuals while the centre microphone captures the instrument as a whole and delivers more complex sound of both manuals which might serve to merge the other two microphones.

### Solution no. 5

The X/Y technique (1,2) combined with two clip microphones (3,4) (*Figure 29*).

The same kind of solution as in the previous example. The only difference is that the centre microphones is replaced by two stereo microphones which deliver a compact stereo image of the whole instrument.

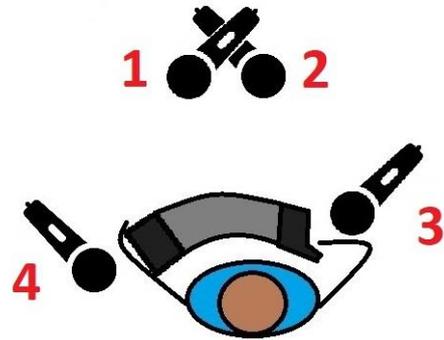


Figure 29

### Solution no. 6

Two clip microphones (1,3) together with a supporting microphone on a stand for the left-hand manual (2) (*Figure 30*).

This solution is good for those kinds of music where we intend to work further with the volume of the manuals,

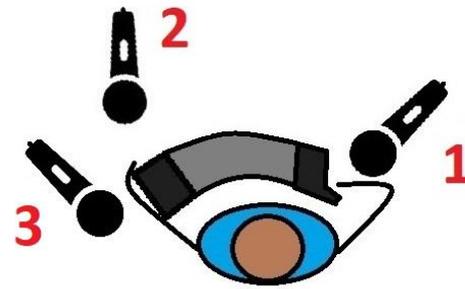


Figure 30

especially with the left-hand manual. These two microphones focused on the left hand allow us to control the character of the left-hand manual. With the microphone 2 we get more of highs, while with the microphone 3 we get warmer and more bass-boosted sound. We can take advantage of this well in the mix afterwards. For example, we can pan the microphones 1 and 2 equally to the sides, and the microphone 3 may stay in the centre in lower volume to emphasises the bass (the technique is comparable with mixing of a common rock band, where the bass sound often in the centre).

### Solution no. 7

The A/B technique (1,2) combined with two clip microphones (3,4) together with a kick drum microphone for the left-hand manual (5) (*Figure 31*).

This solution is very complex and provides a lot of opportunities in terms of further post-production and variable sound character. We need to keep in mind that with higher number of microphones, the risk of phase problems rises.

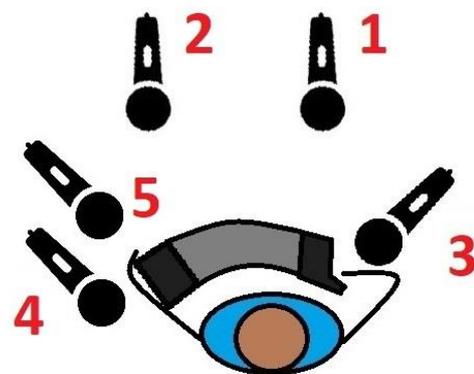


Figure 31

## Solution no. 8

The A/B technique (1,2) combined with two clip microphones (3,4) together with a microphone on a stand in the centre (5) (*Figure 32*).

This is most likely my most favourite studio solution nowadays due to its complexness, versatility and variability. With this one, I have been able to reach the best results of all my tested solutions. If you have an opportunity of using five (or more) microphones, I

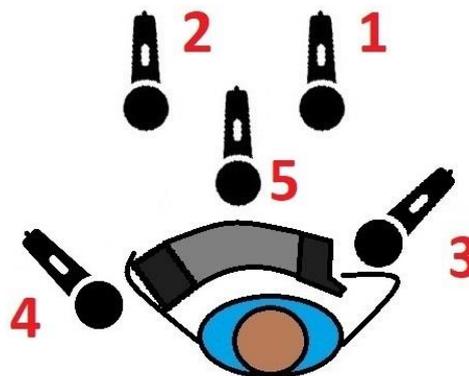


Figure 32

would suggest this solution in most cases.

- **Sound sample no. 35** – AKG C214 stereo pair (1,2) & Rode M5 (3) & Audio-Technica ATM350 (4) & Rode NT1-A (5) – combined solution, 20L/20R & 42L & 20R & C, REVERB, EQ, MULTIBAND COMPRESSOR, LIMITER. I would like to present this sound sample as one of my very best accordion studio recordings, in terms of sound character, that I have made within this research. This solution gives a very rich and complex image of the whole frequency spectrum of the instrument and leaves a plenty of space for post-production adjustments.

If we record the accordion in a room with natural reverb, we should also use ‘room’ microphones placed further away from the instrument to capture the sound of the room. The room microphones are essential in such cases, they bring the ambience and space to the recording. In a studio, we replace the room microphone with different reverb effects.

## 7.2 Accordion in chamber music

The possibilities of miking of the accordion playing together with other instrument(s) are literally endless. It always depends on the composition of instruments that we are recording, on the room, technical possibilities, music genre, musician’s intentions, etc. There is no universal recording solution for this category, however, I would suggest either using any of the previous solutions for solo accordion together with another specific miking of the other instrument(s) or using some of the common recording methods (A/B, ORTF, X/Y, etc) to capture the whole group at the same time. It also depends what amount of mutual leakage we intend to get for eventual work with individual channels in post-production.

## 8 Examples of recording and amplifying of the accordion in practice of other accordion players

In this chapter, I would like to introduce several accordionists, who have large experience with capturing of the accordion in practice, and share their methods and solutions.

First, I would like to share my conversation with the Swedish accordionist and producer **LarsEmil Öjeberget** on this subject. In my opinion, he is one of the most experienced people in Sweden regarding amplifying and recording of the accordion; he reaches an exceptionally high-quality accordion sound both in live performances and in studio recordings. Therefore, I am glad that I can share also his approach and opinion on this theme here.

My approach when recording the accordion is first and foremost what "vibe" I'm searching for. Sometimes I might go for a more "lo-fi" vintage sound, sometimes a fuller rich modern sound and sometimes a very natural sound. It also depends on if I'm recording with a band where there's a bass guitar or other "low register" instruments involved. I also sometimes mix the accordion differently throughout the songs depending of what instruments are plying at the time.

### ***Built-in microphones***

I'm using a built-in microphone system made by Sonus in Denmark. This is according to me the best sounding built in microphone system for accordion. Unfortunately, the specific model I'm using is no longer manufactured. It consists of 8 condenser-capsules, 5 on the treble side and three on the bass side. The amount of capsules is determined by the size of the accordion. This is my starting point when recording and its quite rare that I record without my built-in system. It provides me with a deep and full sound, picking up the bass all the way down to around 20hz, (even though the register of the accordion won't go that far down) and also gives a lot of presence. The downside with it, like with all built in microphones, is that you have to filter away some of the "boxiness " around 300-600hz, mostly on the bass-side.

### ***External miking***

Along with the internal mics I usually want to add on some external microphones when recording, to capture more of the "natural sound" and also the high frequencies that the internal mics sometimes have a hard time reproducing. I like to use a combination of condenser and ribbon microphones such as the Arthur fisher RM5 ribbon microphone along with the Pearl CC22 condenser. I prefer to use AB-miking since it gives me the option of a wider stereo image when mixing and it also helps me find the sweet spot of both the treble and bass side of the accordion.

The reason of using both ribbon and condenser mics is that the ribbon mics usually have a smoother sound and enhances the bass. I can then, later in the mix, balance it along with the condenser mics that have a more detailed reproduction with more of the high frequencies. This helps me find a suitable starting point in the post production without immediately reaching for the EQ.

In some cases I want to limit my possibilities when mixing. In one case I was aiming for a quite "lo fi" vintage sound and ended up using only a SM57 on the treble-side and a DPA 4099 on the bass. It suited the mix very well in that occasion. The limitation of the microphones gave me few choices in the post production and was therefore a bit more "risky" if it wouldn't have turned out the way I thought, luckily it was a good choice.

### ***Mixing***

When mixing I usually start with blending and panning the different microphones to that point where I have a rough mix that will be suitable.

When using a big amount of microphones on a single instrument, there's always the problem with phase issues. I'm therefore quite careful when listening and checking the phase difference between the mics so that I have the best phase relation possible between the microphones in order to avoid phase cancelations and comb filter effects.

One of my "secret weapons" to get a deep rich bass is by sending my line-bass signal through a Ampeg bass-head emulator. This gives me a deep, rich and full bass sound that I really like. I sometimes use the emulation as a parallel processing and sometimes directly on the track. When using it in parallel I have more control of the amount of bass in the mix and I can also compress it separately, add and subtract, to avoid some bass frequencies being louder than others and therefore might interfere with other instruments or making the mix unbalanced.

Usually I like to group-mix the left and right channels (bass and treble). I might use some EQ on the separate tracks, if there's something I want to enhance, and then I submix the treble and bass channels into two separate tracks. On these submixes I use some more EQ if necessary. Using

multiband compression also helps me shape the sound and at the same time helps me even out some of the frequencies that might be too much or less in the mix but still keeping the sound intact since the MBC is working actively. I also use some automation of the individual tracks and submixes if there are passages in the song that requires different characters or if there're melodic lines vs comping that needs to be balanced.

If I'm recording in a quite damped studio I like to use two or three different types of reverbs. A shorter reverb mimics a live room and helps me to widen the stereo image if I need it. A larger hall or ambience reverb gives me depth and size to the sound. Sometimes I use an EFX reverb if I want to achieve some special effect like "pad sounds".

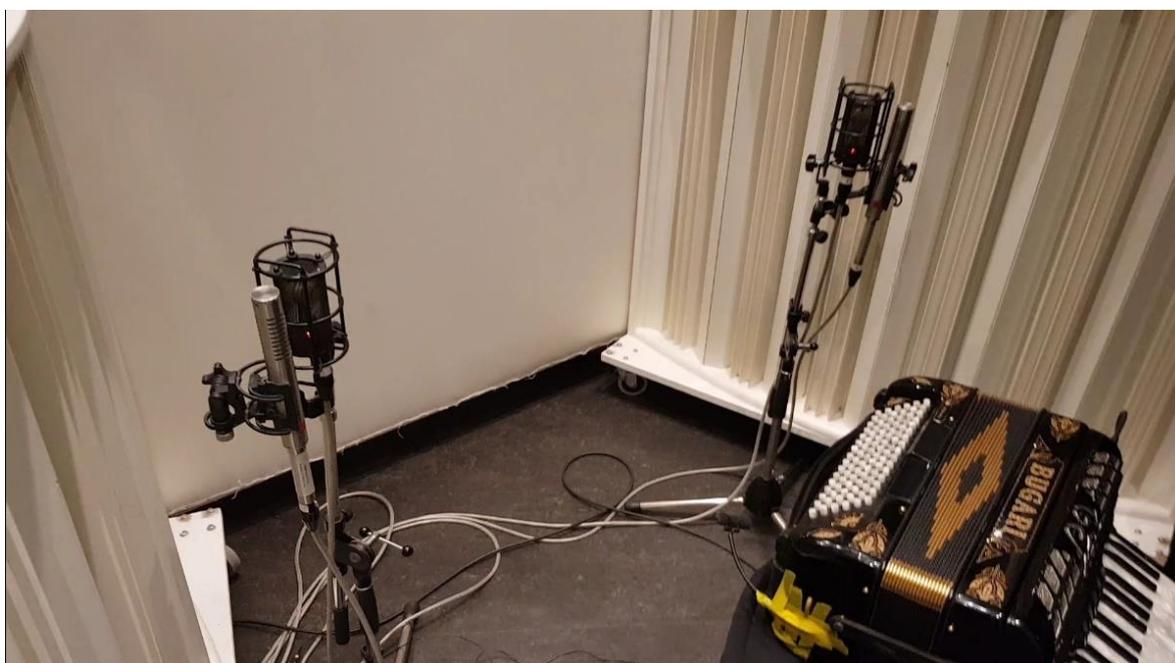
If needed I also sometimes use an exciter or some other saturation to enhance the harmonics.

## **Live**

When playing live I use my built-in microphone system exclusively if I'm in a situation where amplification is needed.

To be able to have my rich bass-sound in the same way as I have in the studio I run my bass line through a "Providence bass station pedal". It helps me have the same deep bass as in the studio. Thanks to the built-in microphones I can have lots of bass and a quite high volume on stage without feedback. Due to the relatively low feedback risks I can have quite good monitoring of myself when playing with loud instruments such as drums and bass. The treble side is going through a "Strymon big sky" reverb pedal which I'm using for both standard reverb and soundscaping (pads and freeze functions). The struggle of playing with other amplified instruments is that you often tend to have a lack of "Bass-side" in the monitoring system. I'm therefore considering to invest in an in-ear system for the future.

I'm not using any external microphones on stage live unless there's a live recording of the gig. Then I might consider using some external mics to be able to have a better mix of the live recording.<sup>15</sup>



*Figure 33: This is a picture from LarsEmil Öjoberget's recording session of Symbio's album "Rising" The microphones used at the time was the Arthur Fisher RM5, Thuresson CM402 condenser, DPA 4099 (On the bass-side) along with the internal mics.*

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<sup>15</sup> Conversation with LarsEmil Öjoberget, 9<sup>th</sup> of October 2018

This is a literal transcription of his opinion on this topic. It is obvious that LarsEmil Öjeberget knows exactly what he does, and his approach to recording and amplifying of the accordion is supported by good experience and knowledge in this area. Particularly interesting is the fact that he uses also his inner microphone system to record the accordion. For recording, I would not suggest using the built-in microphone system alone, but I agree that its usage together with microphones on stands has certain benefits, mainly the possibility to capture very low frequencies which can add another element to work with in certain music genres. In general, he uses the same or similar principles to record the accordion. He also prefers the A/B recording technique, however he engages ribbon microphones there, which gives, as he says, warm sound with slightly enhanced basses. I do not have a personal experience with ribbon microphones but if you have a possibility to use them, I would recommend them as well for recording of the accordion. He also mentions potential problems with phase, which confirms how important this problem is when recording the accordion. He states that he uses solely the inner microphone system in his live performances. Here I would like to point out that this approach of his is based on the music genre he plays and also, to a certain extent, on the type of the accordion he plays. LarsEmil Öjeberget mostly plays more popular music that requires usage of different sound effects and also, he often plays with drums, electric guitars and other loud and amplified instruments. Thus, the usage of the inner microphone system is entirely understandable in this case.

Currently perhaps the best-known progressive accordionist, who experiments with accordion sound and singing using electronic instruments and effects, is the Finnish accordionist and composer **Kimmo Pohjonen** who “*has developed his own custom-made electrified instrument that includes effects, MIDI and other electronics*”.<sup>16</sup>

In his solo program, he uses the wireless in-ear monitor system ShureUHF 801.100, a 31-band equalizer, the TC D2 digital delay processor, 3 multi-effects processors (Lexicon, TC, Eventide, Yamaha 990 or Yamaha 200), 9 channels of compressor-limiters (dbx, BSS), and different pedal effects.<sup>17</sup>

As great examples of perfect accordion sound recorded in a hall with natural and lively acoustics, I would like to mention several CDs by **Mie Miki** and **Richard Galliano** (in my opinion, one of the best accordionists of all time). Regarding Richard Galliano, I would like to point out two CDs that he has recorded for Deutsche Grammophon in Notre Dame du Liban cathedral of Paris. It is *Vivaldi*<sup>18</sup> (2013) and *Bach*<sup>19</sup> (2010). Further, it is worth to mention two solo CDs by Mie Miki. It is *Das Wohltemperierte Akkordeon*<sup>20</sup> (2017) and *S'il Vous Plaît*<sup>21</sup> (2011). These two CDs were recorded by a great sound engineer Hans Kipfer. In my opinion, both the CDs by Miki and Galliano have exceptionally natural and lively sound, capturing the true and balanced character of the instrument in its full frequency spectrum.

When it comes to studio sound of the accordion, my absolute favorite is the Polish accordion group **Motion trio**. It is probably the best-known accordion group nowadays, and I consider the sound of their studio recordings to be the absolute best in the world. They fulfil my idea of perfect, clear, defined, and balanced studio sound of the accordion. Their sound is not harsh at all, rather rounded, and with enhanced, soft and punchy basses. Such a character of the accordion sound I have not heard from any other accordionist or accordion group, especially the basses are almost inimitable. I consider

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<sup>16</sup> Biography. *Kimmopohjonen.com* [online]. [quoted 2018-10-01]. Available from: <http://kimmopohjonen.com/press/biography/>

<sup>17</sup> Kimmo Pohjonen's Sound Rider 2012

<sup>18</sup> Richard Galliano. *Vivaldi* [CD]. Deutsche Grammophon, 2013

<sup>19</sup> Richard Galliano. *Bach* [CD]. Deutsche Grammophon, 2010

<sup>20</sup> Mie Miki. *Das Wohltemperierte Akkordeon* [CD]. BIS, 2017

<sup>21</sup> Mie Miki. *S'il Vous Plaît* [CD]. BIS, 2011

their recordings to be my ideals in terms of sound, and therefore, I would suggest using their recordings as reference tracks in mastering process of most of accordion recordings. The perfect examples of such recordings are the CDs *Accordion Stories*<sup>22</sup> (2018), *Michael Nyman & Motion Trio*<sup>23</sup> (2009) and *Pictures from the Street*<sup>24</sup> (2003).

## 9 Results

Individual results of different sections of this research are partly presented throughout the thesis. However, I list the most important outcomes of the research in several following points. All the statements apply to the accordion, of course.

- In general, condenser microphones seem to be more suitable for capturing of the accordion sound than dynamic microphones. They excel especially in a studio, but they work well even in live performances.
- On contrary, dynamic microphones are preferred when it comes to amplifying of the accordion playing together with louder instruments (drums, electric guitars, etc), and I suggest them also for open-air performances.
- Both for recording and amplifying of the accordion, the cardioid polar pattern will be the most sufficient one in most occasions (as well as the supercardioid and hypercardioid).
- Generally speaking, inner microphone systems are suitable rather for amplification during live performances, but their final sound does not reach the quality of external studio microphones.
- Microphones on stands are the best option for studio recording. They are good for live amplifying as well, however, the potential leakage of other present instruments and the issue of the moving left-hand manual need to be borne in mind.
- Microphones on clips are suitable both for amplifying and recording of the accordion. Nevertheless, they have their little disadvantages as well. In a studio, they work great combined with microphones on stands.
- EQ adjustments of the accordion sound (if needed) should start by cutting the mids and highs slightly, and then boosting the basses a little bit. Especially the low midrange frequencies (300Hz-600Hz) should be slightly reduced to avoid a ‘boxy’ sound.
- Before starting to record in a studio, we should be aware of several things – see the pages 36 and 37.
- The A/B and X/Y recording techniques are the most suitable for studio recording. Their combination with clip microphones is even more effective.
- The optimal distance of the majority of microphones from the accordion is 10-100 cm. If the microphone is too close, it picks up the noise of the mechanics and buttons. If the microphone is placed too far away, we lose the defined and detailed sound and get too much of the room sound.
- When using a clip microphone and a microphone on a stand together for capturing of sound of the left-hand manual, the microphone on a stand should not be placed too close to the manual in order to avoid phase problems and the flanging effect.
- When using only one clip microphone for capturing of sound of the entire right-hand manual, we have to make sure that the microphone picks up the whole range of the manual evenly in terms on volume.

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<sup>22</sup> Motion Trio. *Accordion Stories* [CD]. Akordeonus, 2018

<sup>23</sup> Motion Trio. *Michael Nyman & Motion Trio* [CD]. MN Records, 2009

<sup>24</sup> Motion Trio. *Pictures from the Street* [CD]. Akordeonus, 2003

- The *solution no. 1* and *solution no. 2* (see the page 51) are probably the most effective 2 channel recording solutions for the accordion in my opinion.
- The *solution no. 3* (see the page 52) seems to be the most effective 4 channel recording solution for the accordion.
- As an outcome of my experiments, the *solution no. 8* (see the page 54) meets the requirements for a professional accordion studio sound and will be enough in most of accordion projects.

## 10 Conclusion

During this research, in order to delve deeper into the subject, I have done several things with my accordion that I would not do under common circumstances. I have spent a substantial amount of time in a studio when testing different microphones and recording solutions. I have learned a lot about acoustics, construction and functioning of microphones, I understood the sound string of live amplification, got a lot of new skills in mixing, mastering and using artificial sound effects, learned about a proper usage of various recording techniques, and I had a chance to work with different microphones and professional equipment, visited professional recording studios and talked to interesting people in this field. In general, I have learned how to approach recording and amplifying of my instrument. As a positive personal outcome of this work, I can clearly define what kind of amplification and setup I need in my live performances, I have a very clear conception what my accordion can and should sound like, and I can confidently direct the process of recording on my own. Now, I am able to record, mix and master an accordion recording so it meets high audio standards. My future officially released recordings will serve as a proof of that.

At the very beginning of this thesis, I asked the question *What is the best way to capture the sound of the acoustic accordion*. I knew that I will not most likely find one concrete answer at the end, but the actual exploring of the question was extremely worthwhile because it has brought me all the new skills and knowledge that I have just named above. And I really hope you can get some new knowledge from this thesis as well. There is not one and only way to capture the sound of the accordion, this question is quite subjective and abstract, but that is good in fact since it leaves us room for further exploring, experimenting, discovering and improving in this area.

# 11 References

## 11.1 Literature

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## 11.3 CDs

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Motion Trio. *Accordion Stories* [CD]. Akordeonus, 2018

Motion Trio. *Michael Nyman & Motion Trio* [CD]. MN Records, 2009

Motion Trio. *Pictures from the Street* [CD]. Akordeonus, 2003

Richard Galliano. *Vivaldi* [CD]. Deutsche Grammophon, 2013

Richard Galliano. *Bach* [CD]. Deutsche Grammophon, 2010

## 11.4 Others

Conversation with LarsEmil Öjeberget, 9<sup>th</sup> of October 2018

## 12 Attachments – list of the audio samples

- 1-- Leakage test - AKG C214 - Mono
- 2--A B close - AKG C214 - 100\_100 pan
- 3--A B close - AKG C214 - 50\_50 pan
- 4--A B distant - AKG C214 - 100\_100 pan
- 5--X Y close - AKG C214 - 100\_100 pan
- 6--X Y distant - AKG C214 - 100\_100 pan
- 7--A B close - Rode M5 - 100\_100 pan - hall
- 8--X Y close - Rode M5 - 100\_100 pan - hall
- 9--A B distant - Rode M5 - 100\_100 pan - hall
- 10--X Y distant - Rode M5 - 100\_100 pan - hall
- 11--Distance comparison 20\_30\_100\_150 cm - AKG C214
- 12--Flanging test - AKG C214 & Audio-Technica ATM350
- 13--Deepest tone left manual - AKG C214
- 14--Deepest tone left manual - Rode M5
- 15--Deepest tone left manual - Audio-Technica ATM350
- 16--Bass comparison - AKG C214
- 17--Bass comparison - Audio-Technica ATM350
- 18--Bass comparison - AKG C214 & Audio-Technica ATM350 combined
- 19--Right manual comparison - AKG C214
- 20--Right manual comparison - Rode M5
- 21--Right manual comparison - Audio-Technica ATM350
- 22--Volume test clip mic - Audio-Technica ATM350
- 23--Front middle - AKG C214
- 24--Front right manual - AKG C214
- 25--Right side right manual - AKG C214
- 26--Front left manual - AKG C214
- 27--Bottom middle - AKG C214
- 28--Rear middle - AKG C214
- 29--Rear left side left manual - AKG C214
- 30--Top middle - AKG C214
- 31--Solution 1 - AKG C214 stereo pair - 50\_50 pan
- 32--Solution 2 - Rode M5 & Audio-Technica ATM350 - 26\_21 pan
- 33--Solution 3 - AKG C214 stereo pair & Rode M5 & Audio-Technica ATM350 - 50\_50 & 26\_21 - raw
- 34--Solution 3 - AKG C214 stereo pair & Rode M5 & Audio-Technica ATM350 - 50\_50 & 26\_21 - processed
- 35--Solution 8 - AKG C214 stereo pair & Rode NT1-A & Rode M5 & Audio-Technica ATM350 - mixed & mastered

The audio samples are available on Diva and in this SoundCloud playlist online:

→ <http://www.diva-portal.org>

→ <https://soundcloud.com/user-533583409/sets/recording-and-amplifying-of-the-accordion-milan-rehak-audio-samples>