

Mozart Notation Program & Making a CD

by

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Introduction

Before you read this article, please read what David Webber has already written about this subject on www.mozart.co.uk. Let me state this very clearly: MOZART cannot make CDs directly from the score. MOZART is a notation program without plug-ins for exporting the written score to some sort of an audio file and without any plug-ins for burning a CD with all the properties it needs to do so. Therefore this article is all about creating audio CDs from MOZART's MIDI output.

It is important to realise that creating good quality audio from mechanically generated music is difficult, and the quality of the results will depend on the effort you are able to spend on it.

Microsoft's Wavetable sounds aren't the best, not even with an XP system. I myself use a Window 2000 Professional system and I tried to update to XP twice, but the soundcard in combination with the other hard- and software did not match. So I am sticking to W2000 Pro for the time being according to the time honoured advice: "if it ain't broke, don't fix it."

MOZART is a very sophisticated notation program in the first place with capabilities of playback and recording to and from MIDI. All of MOZART's playback options are to do with MIDI. (Note that a MIDI file is not itself a "sound file" – it is just a sequence of instructions to a synthesiser telling it what sounds to produce.) When starting the playback function an internal MIDI file is generated to be played via the Microsoft Wavetable or whatever other synthesiser device you may have. I have a JV1010 synthesizer with more than 1024 voices (including "instruments" and "effects"). Later I bought an extension card with piano sounds of different pianos, from the great concert grand piano to a jazz electronic piano and everything in between (about 90 different keyboard instruments).

The sound generated by the synthesiser can be recorded by means of a recording program, typically a wave-editor. A lot free wave-editors are available on the Internet. Among "freeware", "shareware", "demoware", "cardware", you should certainly be able to find what you need. In any event the program must have the capability to record the sounds via the soundcard in your system.

To explain: when you playback anything in MOZART, and you hear sound coming from your system, this is produced by a soundcard, (or by sound chips on the motherboard, or by a synthesiser simulated entirely in software). The recording program can record this stream of sound bits. Your soundcard must have MIDI-in and MIDI-out!

Now you have your first composition or arrangement as an audio file. Of course some editing is needed to make it sound "professional", but that is completely up to you. The next step is telling your CD-burning program to put the masterpiece on CD. And voila!, you are now immortal and the next 15 minutes of fame are yours. Until...., yes until you hear the CDs you bought at the local music shop. Different, aren't they? Of course, you and I aren't sound engineers by profession and our mastering is relatively amateurish. If you are curious how to improve this, then you must have patience and above all lots of time. From this point on begins the quest for better music and real immortality and fame.

The very elementary system

For a decent beginners' CD you need in your system:

- a CD burn program plus a CD burner (or course you would say, but I often get questions from people without one or the other);
- a not-too-cheap soundcard with MIDI input and output;
- two speakers or headphones;
- some sort of a wave editing program with recording capabilities;
- a free MIDI sequencer. A sequencer is a program that reads the MIDI instructions and generates sounds via your soundcard (Google for it);
- a mixing panel where the sounds are coming in (from the output of your soundcard) and going out (to the input of your soundcard);
- and last but not least the MOZART notation program.

What next? First make your composition with MOZART, write down all the notes needed and assign instruments to the various strands. I will not go into this further, because I don't know what you are writing. Play it back as often as possible to listen to your own work and set the appropriate dynamics (pp, mf, f). Set if you wish, the stereo panning. Let's say that you are satisfied and ready to launch this masterpiece. Under the File Menu click on export and make a MIDI file of it. As noted above, a MIDI file is nothing other than a series of instructions to your sound system to generate musical notes.

With the free MIDI sequencer you can edit certain items, like "velocity" (which is more the volume of the note than some indication of speed), duration, pedal on or off, etc. To know more about MIDI just Google around a bit and read the many articles on the Net. Both on my website and on the MOZART site, there is a link to a very extensive explanation of MIDI made by Jeff Glatt.

Now that your MIDI file is fit for further processing, play it back (Windows media player will do it also). Some MIDI sequencers have an export function. That is to say that they make a sound file for you without the need for the wave editor. If not present, then you have to load your wave program first and set it to record the incoming stream. After that, start the sequencer with the playback facility. Now all your music will be recorded and via the wave program saved on the hard disk. From there it is your responsibility to set everything for burning your masterpiece to CD, so I will skip this subject and come to that later in this article.

Very basic, isn't it? Yes and that is exactly how I begun. Now after two years of struggling with this material, I am still not completely satisfied. Why not? Because synthesized sound, as it is, never can beat the real thing. Just imagine Ben Webster blowing his sax. How do you record or mould your sounds to that very particular tone with all the unbeatable breathing he used? Or a church organ? Or a violin? Even though there are many good and sometimes very good Grand Pianos nothing can beat a real Steinway, Bösendorfer or Schimmel. But don't be too disappointed. Occasionally some users of software come with excellent ideas e.g. to mimic the resonance of the wooden body of the piano. This also applies to the violin, cello or else. Let's continue with the rest of this article.

Just a remark: the text above applies to most of the very elementary systems. There are always different solutions for it. If you have a SoundBlaster-like card you can import so called soundfonts of different instruments. A soundfont is basically nothing else but a series of sampled musical elements to give a certain sound. See the analogy with character fonts. Some soundcards can import soundfonts and bypass the Microsoft Wavetable. Another solution is using the little program SynthFont, which can import soundfonts as well and playback without the need of those SoundBlaster-like cards. There are lots and lots of different soundfonts free on the Internet.

The first steps to fame

I understand from the Yahoo MOZART forum (in the past and from recent polls) that only a few users really make full recorded compositions of their own. Many just make arrangements for bands, Big Bands, church hymns, etc. Occasionally somebody writes about the making of orchestral works with the help of some sort of orchestral sample bank (like Vienna or Garritan). All but a few want to make it sound right, because they don't own a band or church organ.

Let us say that we all want a fairly decent sound to put on CD. Although it is very difficult to give an advice, and everything depends on one's personal needs, the following may be useful.

Tuning Windows

First of all Windows. The tuning of Windows is rather complicated, but I give it a try here. Please, have look at Tweakheadz www.tweakheadz.com and the cakewalk site www.forum.cakewalk.com/tm.asp?m=590758. They have numerous articles about tuning your system and necessary hardware.

To shorten things:

- get rid of all useless things, which run when starting your system, including:
 - o screensavers
 - o energy savers
 - o all time depended processes (scheduler)
 - o needless start-up loading of programs, for example the MS Office toolbar
 - o some other CPU consuming settings or memory consuming settings, like
 - § too many character fonts (see Configuration) you will never need – they are loaded and checked at start up time (they say);
 - § other processes - you know better than I do - that consume computer power
 - o if you have two hard drives in your system, let the swap file be on the second hard disk – and assign enough memory
 - o with 512 Mb things can be done, but 1 Gb is better
 - o if you can have a dedicated machine which is not networked – in particular not connected to the internet – then it may also help to disable firewalls, as well as spyware/virus checking programs, but this may be inadvisable if you have an internet connection active (open?)

But why should we do this? Some sequencers and recording processes consume so much computer power that they need all system resources. When not fully available you will hear hiccoughs and crackles while playing back that song, especially when there are multiple staves involved or complicated scores with pedals, glissandos, or speed(tempo) changes . It is fully up to you to decide if you want to close down the “safety” features on your computer. My adagio is that when I am making music I am not looking at Internet, so no connection is made with the “ugly outside world” filled with deadly viruses, spies and intruders.

The software

First of all the MOZART Notation Program. Without this, life is senseless. Use any template if you feel the need, otherwise design your own and **export** this onto the **Template folder**. Be careful in what you design, especially when talking of different instruments. But I will not go into this further, David has already done so.

Next any MIDI sequencer, preferably with an audio export function. I use Cubasis 5.0, a buggy program from Steinberg and it costs just about Euro 60,- (an update from Cubasis 4.0). This small program needs very careful handling, sometimes it will “hang” or destroy your MIDI-tracks. So keep a backed up version.

Some instruments in the form of VST instruments or Soundfonts. When you search for SynthFont on the Internet, that website also contains links to several soundfont libraries (at least the last time I looked). Of course you also can buy them from Sonic Implants and other manufacturers.

And at last a Wave editor with more recording capabilities than Windows offers you as a standard. There are lots of them on the Internet. I almost forgot the CD burning program, but I reckon that is obvious.

Preparation of your score

Go back to MOZART and your score. Write down which instruments you use on which channels. Then import the MIDI file into your elementary MIDI sequencer and assign instruments to the various channels as written down. Listen what the “system” makes of it. Mostly it is not what you thought, therefore try to establish what went wrong and correct this in the score. I think that those corrections basically will be dynamics (ppp, pp, p, mp,) Don't think that when you enter a “mf” on a certain stave it will apply to all staves. No, you have to set the dynamics for all staves.

I mostly write for piano, so I use the pedal symbol. Normally in MOZART you must assign the pedal also to every stave, but I won't. In the end I use the Grand Piano Virtual Instrument and the pedal command applies to all staves/channels in MIDI – there is only one sustain pedal attached to a piano, you know.

This listen-and-go-back-to-the-score is cyclic. Do it every time and after a good night's sleep listen again to your played back MIDI file. Finally you are satisfied.

Preparation of your MIDI file and your first CD

We still haven't discussed anything about editing a MIDI file. The first CD I made was back in the early 21st century and I didn't know how to edit a MIDI file. I was rather satisfied and stayed satisfied until I heard again some other music of the same sort.

But to mention what I used, so you can start now:

- MIDI2WAVE à a very simple program that renders (output) a wave file to the hard drive, using the instruments I assigned to the various channels;
- Cool Edit Pro, I inherited from my efforts to put all vinyl records on CD;
- Nero CD Burning Software

In summary:

Sound flow: à MOZART score à MIDI exported à MIDI imported into MIDI2WAVE à output to Wave-file à Wave file edited with Cool Edit Pro à ready piece of music à Nero à CD.

Programs: MOZART, Midi2wav, Audacity or WavePad (free audio editing programs), Nero (I am sure some free CD burning programs are available).

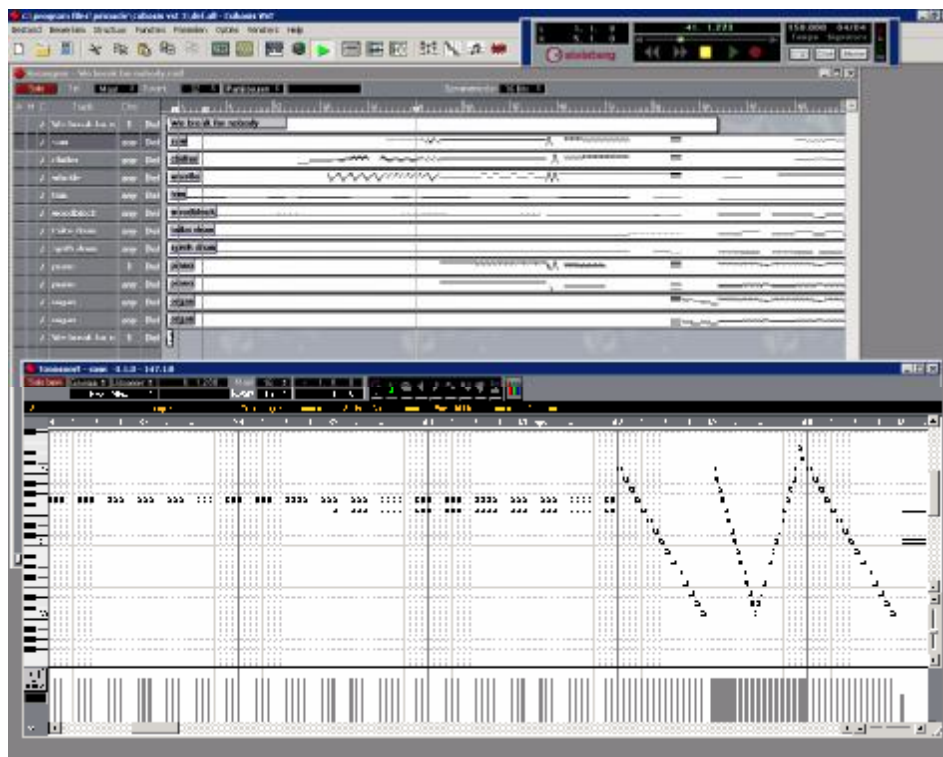
Now for the high-school of making your CD

First the MIDI editing

This is not yet the university of CD-making, but you will end up with better sounding CDs. We start again with the unbeatable MOZART Notation program and after time-consuming alterations we think the score is fit for output. In this score editing think of elements like: amending the tempo (under Layout) a bit for those parts screaming for a bit of rubato.

Don't forget to add the necessary crescendos en decrescendos. Sometimes an Fz or accent makes the piece a bit spicier (and less mechanical) than just all at one tempo or level of volume. The swing function is an unknown for me, because I don't use it and don't need it, but for jazz pieces it may be worth experimenting with it.

Once your score is ready for exporting, save this as a MIDI file (export function) and keep a backup in some safe place, because you are about to edit it heavily. As noted above, I use Cubasis 5.0 VST and this is not the best program to do some editing, but I cannot afford other programs like Cubase SX.



Figuur 1 - Cubasis' events list

Now the time for a demo version is here. Try the following programs:

- MIDI2WAV, the last time I worked with it, the possibilities were very limited. You could only assign different MIDI patches to the parts and let them playback and output an audio file, part by part. I had to combine these parts with Cool Edit into one huge audio file;
- MIDIMAESTRO, is a very cheap program with extensive possibilities to edit your MIDI file. It can playback via VST instruments and/or DirectX made plug-ins. It has no render facility, so you have to set your Audio Recording program ready for recording. On the other hand, one can use MIDIYoke or similar to start recording automatically.
- SYNTHFONT, also cheap, can be used to export audio files, with the help of sound fonts (with or without a SoundBlaster card).

- Sorry, but you have to find out yourself how the free audio editors work. Since I was a long-time Cool edit user, I could update to Adobe Audition very inexpensively. This program is almost as good as WaveLab from Steinberg.

After some weeks of trying you will end up with your very first, more or less sophisticated, "Audio Studio" and your first audio file will see the light and is ready for releasing it to the public. Not quite true, but it is a good starting point. This audio file consists of several tracks each with a different instrument. I consider the piano as an instrument with two voices: treble and bass. Those two voices can be divided into another two voices. So I end up with four voices upper treble, lower treble, upper bass and lower bass. I have 4 MIDI tracks.

The big question is: are those 4 tracks in balance? Do they sound united or as 4 different voices each with its own dynamics? Is it really necessary to have the treble at a higher volume than the bass parts? So, which instrument or voice would you like to sound as a solo? This inevitably leads to amending your MIDI file, mostly on the command velocity. And every time you will playback your composition in full until you think this is it! Then go to bed and take a day off. Play it the next morning. Is it still true? Sometimes, you forgot a note, it is too soft and it sounds better when you increase the velocity.

This cyclic process is most time consuming. Sometimes I spend several days to edit my MIDI files to the level I like. And I go to bed and listen the next morning to check if it is still alright. Eventually it is as I want it. The first audio file is rendered and put in a safe place.

Think this over: combining multiple voices into one file will alter the characteristics of the sound of the other voices. The frequencies of the trumpet influence the frequencies of the saxophones, trombones, etc. They all work together. So you cannot play this piece only track by track (thus voices separated). After amending the individual voices you have to play it back as one composition to see if the interaction between the instruments still fits your idea of that song. That is what I do with piano compositions. I amend the individual voices, listen to them separately first and later in combination with the other voices. If it sounds "in harmony" then I consider this passage as ready for output and go to the next.

This is an ever-continuing story, but somehow you will end up with several pieces. Now the audio editing will start. Suppose you skip this and burn your CD. You will notice that the pause between the pieces is not consistent. Also the volume, the overall sound is different from piece to piece.

Basics

Chorus and Reverb MIDI

Here we have to make a decision. Where do I make my editing, in the MIDI file or the Audio file. Personally, for piano music I do all further editing on the audio file with Adobe Audition, but I know that you can also edit the MIDI file. I recommend MIDIMAESTRO.

First the Chorus. One flute sounds very thin, two sound better and are a bit out of tune, three is a problem. That is what chorus does. It multiplies the sound as if there are more of them. Try it, despite it, use it, but be very careful.

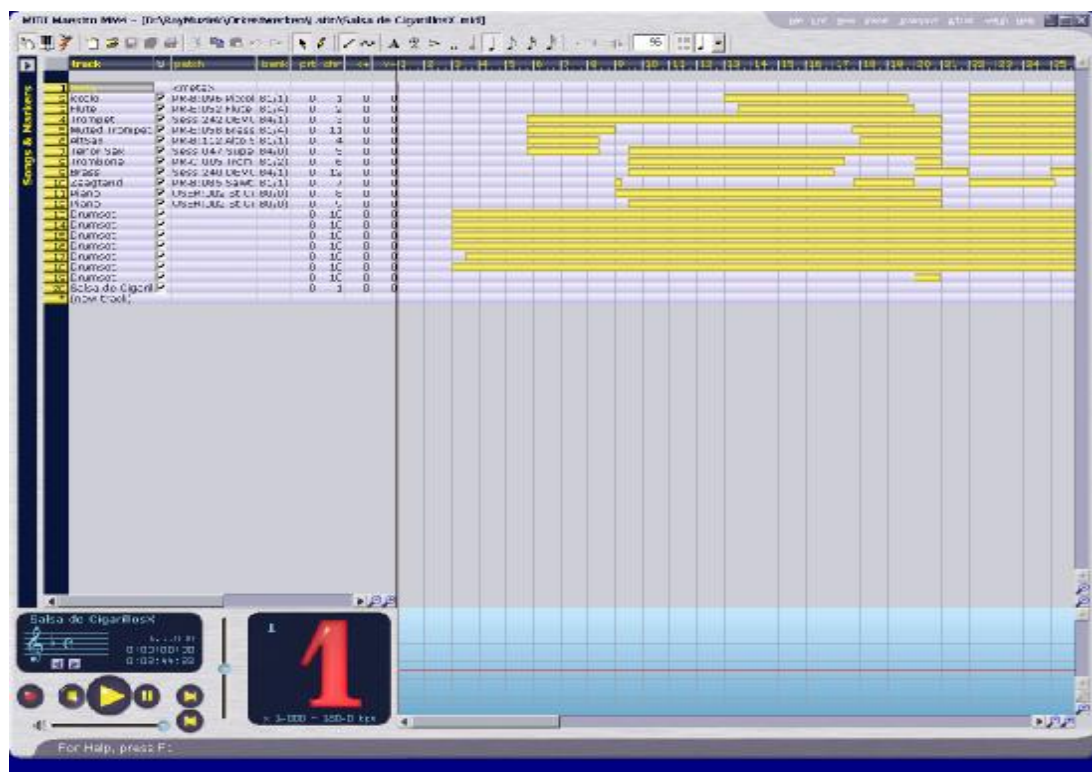
The Reverb is a different story. This needs some very cautious approach. Do you really want your Big Band playing in a cathedral? Or do you prefer a smaller ambience? How about the reverb for that particular sax sound (the solo)? Should this be sound with a bit more reverb than the other instruments? Normally, you would think that the reverb should be the same for all instruments? That is not completely true, but beware of overdoing things. With a bit more reverb for that trumpet solo you can enliven the overall sound. (In real performances, musicians try to "project" more when playing a solo, and we can try to duplicate this.) Another function can add some more pepper to this dish.

The brighten function MIDI

With this function you can alter the nature of the instrument from just a dull sounding trumpet to the sound of Trumpet Voluntary. I noticed that with some synthesized sounds adding a bit more brightness make things more interesting, transforming the tenor sax into an alto sax. I don't know if you know it, but when you play the tenor sax and raise the notes one octave it still sounds as a tenor sax, it will not become an alto. But with brightness you can get nearer to the real timbre of the alto.

Other midi functions - and a last word about velocity MIDI

Of course I won't discuss all different MIDI commands here, this is for you to do and to experiment in the next couple of days (or weeks). An instrument, which is played by a human being – as all instruments but the pure electronic, synthesized instruments are – react different on velocity. Think of a Grand Piano, when hit softly the sound is smooth, but when hit harder (or very hard) the sound (timbre) is completely different. You cannot solve this by amplifying the wave file. You lose that particular sound of the strings. I reckon that the same applies to other instruments, especially woodwinds. Blowing with a certain force into the mouthpiece gives a different sound than the more mellow ones.



Figuur 2 A view of MidiMaestro

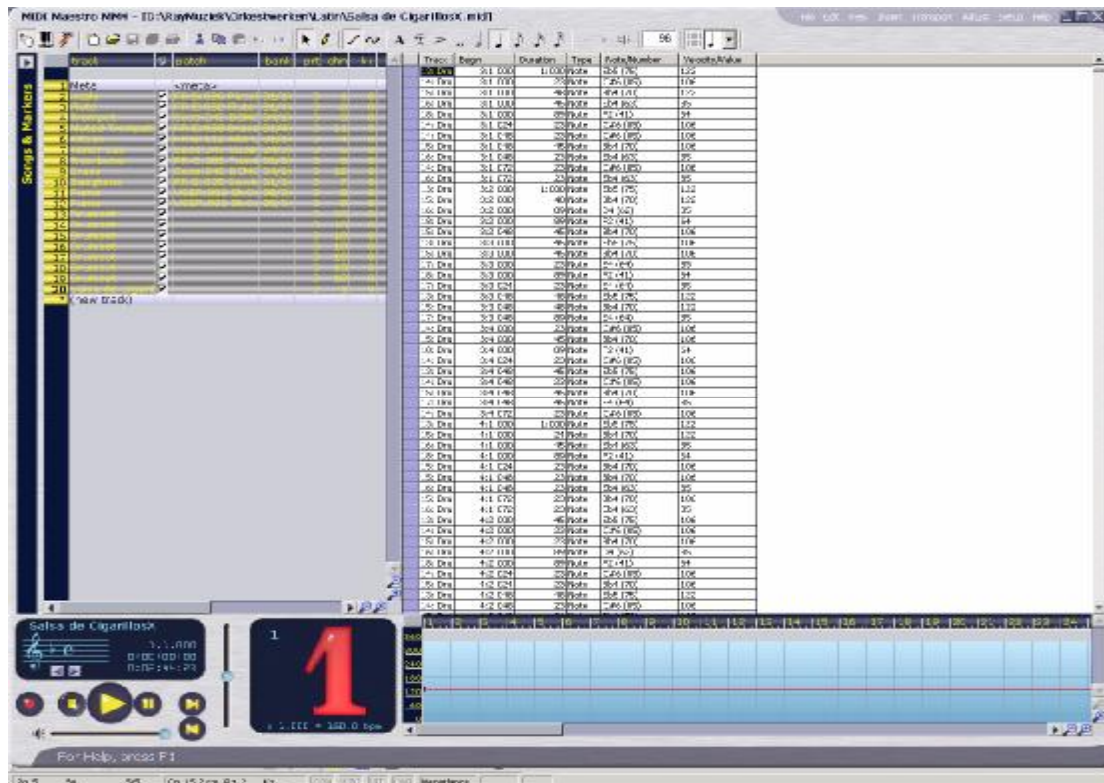


Figure 3 - Another view of Midi Maestro - events

Editing the audio file(s)

We now have to master the Audio files, which are subject to your CD with a number of different tracks (here tracks means different songs, not the different voices. For the sake of understanding I shall use the term "voices" for the different instruments and "tracks" for the number of songs/pieces).

Suppose we have a song with 6 voices/instruments, a sextet (which has nothing to do with sex). Instruments are: clarinet, trumpet, sax, string bass, piano and drums. We also have six different wave files, one for each instrument. With Adobe Audition you can have those 6 wave files in one window, all aligned to the very millisecond.

For now, just quit this exercise and have a long walk. Think of combining those into one smashing song, blowing your relatives from their chairs. Come back and work out what you memorized during your long walk, without any sound if possible.

Who is the soloist? The trumpet or the sax? Or do we want some changing of soli, trumpet first, then the piano, an astonishing drum roll, etc. You know better than I what this piece should be.

Overall volume – the danger of clipping

Having six voices in one file and playing them together will end up with clipping (distortion) because they all have their own dynamics. Roughly said: adding six times the f-dynamic (in music the *forte*) results in a theoretical maximum of 480-540 (as forte in MOZART is MIDI velocity 80 or near 90). So (de-)amplify every voice with the amount of -6 to -10 dB to begin with.

This gives you some headroom for further processing. The process now is described as discriminative editing, because every voice is separated from the others. Be extremely careful what to amplify. It can make or break your song. You have to experiment a lot.

Some hints

I cannot go deeper into this, because for everybody it is different. You have to decide which parts, which voices, etc. are subject to amplification. I only can give you some mathematical hints of how a wave file reacts on the various stages of processing.

Pause between the songs

With your Audio editing program you can cut the silenced parts and add some seconds to the beginning and the end. Common is two seconds of silence at beginning and end of a piece. The CD burning program puts two seconds of silence between the tracks, so you will end up with 6 seconds of nothing. I write piano pieces of several parts and at the very beginning I allow for 4 seconds of silence (together with the 2 seconds of the burning program, that gives me 8 seconds of silence, taking into account the next 2 seconds of the following part). The parts between are separated by 2 seconds at each beginning and end.

Amplification does not alter the image of the wave file, it only sets certain bytes to a different value. For those who are curious how about a wave file looks like, Google with the term Wave file format or similar.

Dynamics doesn't alter the image of the wave file, but compressing cuts the edges, highlights some areas of amplification, etc. Compressing is in fact making the file sound softer and highlighting other areas (making it a bit more louder). People think that compressing is some sort of amplification. It is not. It sets all the bits and bytes in the wave file to different values. The result is that mostly (using the classical soft knee) the rough edges are cut, so you can amplify the wave file a bit further.

Equalizing is only altering the volume of some frequencies or groups of frequencies.

I have noticed that some sound fonts, sampled instruments (Gigasample), and even The Grand VST from Steinberg lack performance in the midsection of the total pitch range. With a piano the midsection lies between 180 Hz and 900 Hz. Depends on the song of course, but most of the time I put some extra effort in this section while equalizing.



Figure 4: Equalizing with -15 dB output - mid section amplified

Reverb is the word. Ever heard recordings of Elvis in Las Vegas? Yes, then you know that without the reverb it sounds dull. But on those records from the past they overdid it a bit. For instance a piano playing in a cathedral isn't right. The piano is meant for playing in a rather dry ambience, like a small church or big living room. So you have to limit your reverb (or echoing) to a minimum. Watch out for the headphone temptation! The headphones always give you another perception of the sound than your living room with real high-fidelity speakers. I spent many weeks and many CDs experimenting to find out what the best reverb was.

To point you to some interesting development I am obliged to mention the Impulse Response techniques. Nowadays the music professionals have invented a new approach of adding some reverb to your songs. Do some investigation yourself, but basically it comes to multiplying your sound with a particular sound file mimicking the space of a concert hall, church, wooden ambience, etc. What they do is in principle the following: they carry their recording equipment to a spatial area, set everything ready and clap in their hands. This sound and their echoes are recorded, giving the characteristics of that spatial area. Adding this to your sound file (multiplication) will amend your sound file as if it was recorded in that particular concert hall, church, theatre or the Royal Albert Hall (to mention a famous concert hall).

Using professional Impulse Responses is very costly, but there are some free and fairly good free examples on the Internet. Try Googling for SIR, yes just that, and you will find a free Impulse Response processor with links to Echochamber containing lots of impulses. A pity, there are just two or three piano impulses, so I made my own reverb settings within Adobe Audition.

Reverberation is very dangerous, though. Above a certain point your sound, your trumpet, my Grand Piano, will sound very harsh. I asked some professionals for advice and they re-

commended me to lower (with equalization or with “colouring” the reverb) the frequencies higher than 3800 Hz. So I did and the result was better. But another thing is coming around the corner and that is “air” or transparency. I learned that when you lower the frequencies above 8000 Hz or 9000 Hz with 12 dB and raise it again from 12000 Hz with 12 dB or more (up to the very end of your hearing: let us say 19000 Hz) it gives room for the sub-harmonics and the result will be better. Experiment!!

And now the two seconds extra silence at the end of each track (part of a sonata, the song, that arrangement) will come very handy. Adding *reverb* to a wave file alters the shape of the wave file! You have to do some reading about reverbs yourself, but shortened it comes down to adding some extra room for the reflection of the sound from the walls. It takes several milliseconds (or even seconds) to die out completely. So the tail of the reverb needs some extra space at the end of the audio file.

Normalizing is the technique to get all the different songs to the same level of amplification. When you want to put several songs on a CD most of the time they aren't balanced in volume. When your audio editor allows for it, put them all together in one file and look at the level the wave file is represented. You will see that one or two songs need individual amplification by just 2 or 3 dB. Do so. Then look at the wave file as a whole and try to establish if the loudness goes to the very end (0 dB). If not, take the function *normalize* to amplify all audio files to the very edge of distortion. Experiment! This will result in an overall balanced CD.

Be creative! And put the most interesting song first on the CD. Listen to that commercial CD. Why did you buy it in the first place? Because having listened to one or two songs (from the beginning) you are enthusiastic about it and the sale is made. At home the next 12 songs aren't dull, but not as exciting as the first two. So be a merchant yourself and astonish your audience with that window-glass-breaking song.

Editing your ears

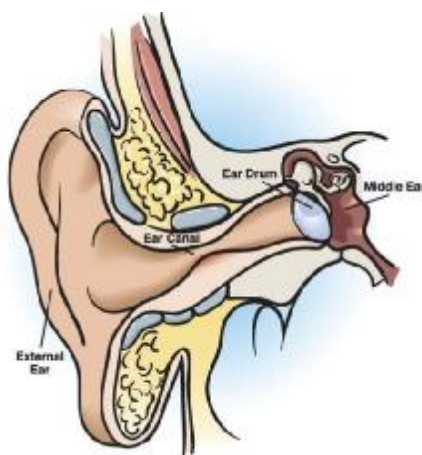
This last subject is the most important one. Using a set of more or less studio headphones is very good for the rough editing of your music. But be aware of the pitfalls. Your brain will get accustomed to that sound and alter it into the perception of your favourite band or orchestra. I monitored this process myself. After having listened to my unedited music with headphones it sounded like a performance of Maurizio Pollini at the Concertgebouw playing a Steinway. Putting it on CD and playing this in my living room with very high quality speakers revealed that it sounded like a very cheap piano. So, the headphones cheat your brain or your brain is cheating your ears. Therefore I said, have a good night sleep and listen again the next day. Your ears are "reset to normal perception" during the night.

Better solutions are speakers attached to your equipment. There is a discussion going on which type of speakers to use. Bob Katz, one of the better audio engineers, says that near field monitors aren't the best solution and he prefers a set of good sounding passive speakers. But comment on this is that with the latter you have to throw in an amplifier, with all the distortion given. The “active” monitors have at least their own calibrated amplifiers built-in. So who is right? I don't know.

When listening to your masterpiece with or without headphones, don't listen too long at one sitting. Take a break every half-hour to preserve your hearing capability. We amateurs completely depend on our ears; we aren't another Beethoven who could compose marvellous pieces without decent hearing, just by combining his skills as a composer and the theory burned into his brains.

Aside: you can edit your hearing capabilities by using some sound therapy devices and special edited music. See literature below.

HAVE FUN FOLKS. For the time being this is it and I hope you will find enough tips to get to that real hall of fame with golden footsteps in the streets of Beverly Hills.



Figuur 5 - Our precious hearing device

The Hague, 25 September 2005

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Literature:

*The iZotope manual free downloadable "Mastering with Ozone" www.izotope.com

*Midi Technical Fanatic's Brainwashing Center "Midi is the language of gods"
www.borg.com/~jglatt/

*Het MIDI basisboek (in Dutch) Shiva Digital Music Applications ISBN 90-73708-05-2

*Mastering Audio – the art and the science, by Bob Katz, Focal Press, ISBN 0-240-8-545-3

Many articles from the Internet, i.e.

*SoundOnSound magazine

*Tweakheadz

*www.mozart.co.uk

.... And many others, other forums, usersgroups, etc.

Hearing

Look for Dr.Tomatis, Ingo Steinbach, and others on "sound therapy" or "hearing equals behaviour".