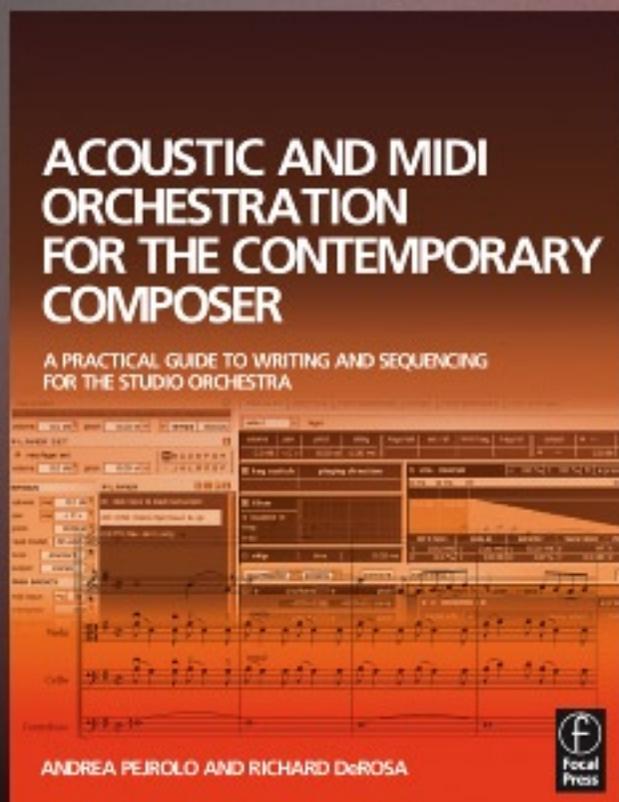


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**Acoustic and Midi
Orchestration for the
Contemporary Composer**
Pejrolo and DeRosa
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1 Basic Concepts for the MIDI Composer, Arranger, and Orchestrator

1.1 Introduction to MIDI and audio sequencing

If you are reading these pages you probably already have some basic experience of either composing or sequencing (or maybe both). The purpose of this chapter is to ensure that you are up to speed with some of the key concepts and techniques that are needed in order to learn advanced orchestration and MIDI production procedures. In this chapter we will brush up on the concept of MIDI, audio, and MIDI network, then review a detailed description of MIDI messages, studio setup, and more. After covering the technical part of the production process we will focus on the main principles on which orchestration, arranging, and composition are based. You will become familiar with such concepts as range, register, overtone series, transposition, balance and intensity, and many others. These are all crucial and indispensable concepts that you will use to achieve coherent and credible MIDI productions.

As you will notice, in the majority of the chapters of this book we follow a structure in which the principles of MIDI sequencing and the traditional rules of orchestration alternate, in order to give you a solid background on which to build your MIDI sequencing and production techniques. It is much easier to try to re-create a convincing string section if you first wrote the parts as if they were supposed to be played by a real set of strings. This is a basic concept that you always should keep in mind. No matter how sophisticated (and expensive) your sound library is, the final result of your production will always sound unconvincing and disappointing if you don't compose and orchestrate with the acoustic instrumentation and real players in mind.

Many composers believe that writing and orchestrating for a MIDI ensemble is easier than working with a real orchestra, because you don't have to deal with the stressful environment of live musicians. In fact, the opposite is true. Trying to re-create a live ensemble (or even an electronic one) with the use of a MIDI and audio sequencer and a series of synthesizers is an incredibly challenging task, mainly because in most situations you will be the composer, the arranger, the orchestrator, the producer, the performer, the audio engineer, and the mastering engineer, all at the same time! While this might sound a bit

overwhelming, this is what makes this profession so exciting and, in the end, extremely rewarding. There is nothing as rewarding as when you finish your production and you are completely satisfied with the final result.

Before we introduce more advanced orchestration techniques, let's review some of the basic concepts on which MIDI production and orchestration are based. While some of these concepts (such as the MIDI standard and common MIDI setup) will be reviewed only briefly, others (such as control changes, MIDI devices, and MIDI messages) will be analyzed in detail, as they constitute the core of more advanced MIDI orchestration and rendition techniques. Keep in mind that to fit a comprehensive description of the MIDI standard and all its nuances into half a chapter is very hard. The following sections represent an overall review of the MIDI messages with an in-depth analysis of the control change messages, since we will frequently use this type of message to improve the rendition of our scores. For a more detailed look at how to set up your MIDI studio and at the basic of the MIDI standard I recommend reading my book "Creative Sequencing Techniques for Music Production", published by Focal Press, ISBN 0240519604.

1.2 Review of the MIDI standard

MIDI (Musical Instrument Digital Interface) was established in 1983 as a protocol to allow different devices to exchange data. In particular, the major manufacturers of electronic musical instruments were interested in adopting a standard that would allow keyboards and synthesizers from different companies to interact with each other. The answer was the MIDI standard. With the MIDI protocol, the general concept of "interfacing" (i.e., establishing a connection between two or more components of a system) is applied to electronic musical instruments. As long as two components (synthesizers, sound modules, computers, etc.) have a MIDI interface, they are able to exchange data. In early synthesizers, the "data" were mainly notes played on keyboards that could be sent to another synthesizer. This allowed keyboard players to layer two sounds without having to play the same part simultaneously with both hands on two different synthesizers. Nowadays, the specifications of MIDI data have been extended considerably, ranging from notes to control changes, from system exclusive messages to synchronization messages (i.e., MTC, MIDI clock, etc.).

The MIDI standard is based on 16 independent channels on which MIDI data are sent and received by the devices. On each channel a device can transmit messages that are independent of the other channels. When sending MIDI data, the transmitting device "stamps" on each message the channel on which the information was sent so that the receiving device will assign it to the correct channel.

One of the aspects of MIDI that is important to understand and remember is that MIDI messages do not contain any information about audio. MIDI and audio signals are always kept separate. Think of MIDI messages as the notes that a composer would write on paper; when you record a melody as MIDI data, for example, you "write" the notes in a *sequencer* but you don't actually record their sound. While the sequencer records the notes, it is up to the synthesizers and sound modules connected to the MIDI system to play back the notes received through their MIDI interfaces. The role of the sequencer in the modern music production process is, in fact, very similar to that of the paper score in

the more traditional compositional process. You “sketch” and write (sequence) the notes of your composition on a sequencer, then you have your virtual musicians (synthesizers, samplers, etc.) play back your composition. This is the main feature that makes MIDI such an amazing and versatile tool for music production. If one is dealing only with notes and events instead of sound files, the editing power that is available is much greater, meaning that one is much freer to experiment with one’s music.

Every device that needs to be connected to a MIDI studio or system must have a MIDI interface. The MIDI standard uses three ports to control the data flow: IN, OUT, and THRU. The connectors for the three ports are the same: a five-pin DIN female port on the device and a corresponding male connector on the cable. While the OUT port sends out MIDI data generated from a device, the IN port receives the data. The THRU port is used to send out an exact copy of the messages received from the IN port. Nearly all professional electronic musical instruments, such as synthesizers, sound modules, or hardware sequencers, have built-in MIDI interfaces. The only exception is the computer, which usually is not equipped with a built-in MIDI interface and, therefore, must be expanded with an internal or external one. Nowadays, the computer (along with the software sequencer running on it) is the central hub of both your MIDI and audio data, becoming the main tool for your writing and arranging tasks. While the synthesizers, samplers, and sound generators in general may be referred to as the virtual musicians of the twenty-first century orchestra, the computer can be seen as its conductor.

Depending on the type of MIDI interface you get for your computer and sequencer, you can have two main MIDI configurations: daisy-chain (DC) or star network (SN). The DC setup is mainly used in very simple studio setups or live situations where a computer is (usually) not involved; it utilizes the THRU port to cascade more than two devices to the chain. In a DC configuration, the MIDI data generated by the controller (device A) are sent directly to device B through the OUT port. The same data are then sent to the sound generator of device B and passed to device C using the THRU port of device B, which sends out an exact copy of the MIDI data received from its IN port. The same happens between devices C and D. A variation of the original DC configuration is shown in Figure 1.1, where, in addition to the four devices of the previous example, a computer with a software sequencer, and a basic MIDI interface (1 IN, 1 OUT) are added.

In this setup, the MIDI data are sent to the computer from the MIDI synthesizer (device A), where the sequencer records them and plays them back. The data are sent to the MIDI network through the MIDI OUT of the computer’s interface and through the DC. This is a basic setup for simple sequencing, where the computer uses a *single port* (or single cable) MIDI interface; that is, an interface with only one set of INs and OUTs.

For an advanced and flexible MIDI studio a multi-cable (or multi-port) interface is really the best solution, as it allows you to take full advantage of the potential of your MIDI devices. By using a multi-cable interface all the devices connect to the computer in parallel; therefore, the MIDI data won’t experience any delay, as may occur when using the DC setup. This configuration, involving the use of a multi-cable MIDI interface, is referred to as a *star network*. One of the big advantages of the Star Network setup is that it allows one to use all 16 MIDI channels available on each device, as the computer is able to redirect the MIDI messages received by the controller to each cable separately, as shown in Figure 1.2.

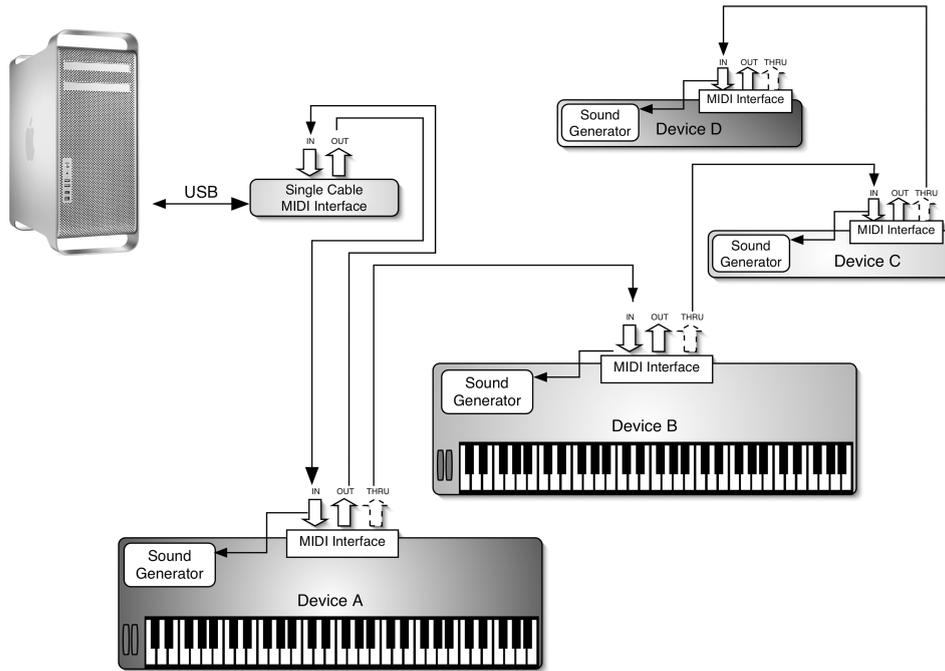


Figure 1.1 Daisy-chain setup (Courtesy of Apple Inc.).

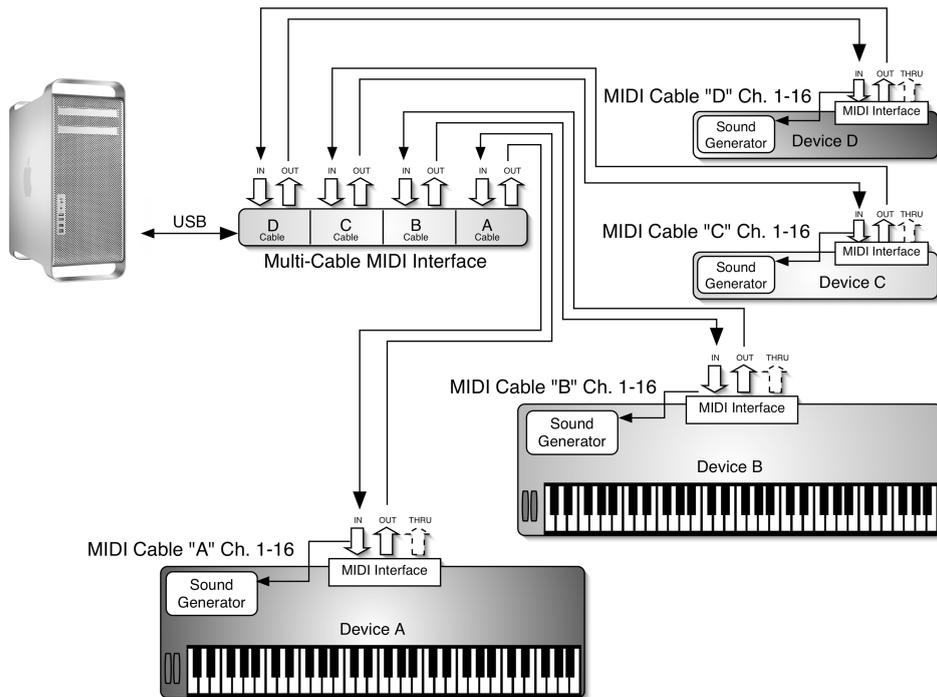


Figure 1.2 Star network setup (Courtesy of Apple Inc.).

In order to exploit fully the creative power offered by the MIDI standard it is crucial to precisely know and identify the MIDI messages that are available to us. While you may be familiar with some of the most common messages (e.g., Note On, Note Off), there are many others (CC#11, CC#73, CC#74, etc.) that are essential if you are trying to bring your MIDI productions to the next level. Let's take a look first at the main categories of the MIDI standard.

1.3 MIDI messages and their practical applications

The messages of the MIDI standard are divided into two main categories: channel messages and system messages. Channel messages are further subdivided into channel voice and channel mode messages, while system messages are subdivided into real-time, common, and exclusive messages. Table 1.1 illustrates how they are organized.

Table 1.1 List of MIDI messages organized by category

Channel messages	System messages
Channel voice: Note on, Note off, Monophonic aftertouch, Polyphonic aftertouch, Control changes, Pitch bend, Program change	System real-time: timing clock, start, stop, continue, active sensing, system reset
Channel mode: All notes off, Local control (on/off), Poly on/mono on, Omni on, Omni off, All sound off, Reset all controllers	System common: MTC, Song position pointer, song select, tune request, end of SysEx
	System exclusive

1.3.1 Channel voice messages

Channel voice messages carry information about the performance; for example, which notes we played and how hard we pressed the trigger on the controller. Let's take a look at each message in this category in detail.

Note On message: This message is sent every time you press a key on a MIDI controller. As soon as you press it, a MIDI message (in the form of binary code) is sent to the MIDI out of the transmitting device. The Note On message includes information about the note you pressed (the note number ranges from 0 to 127 or C-2 to G8), the MIDI channel on which the note was sent (1–16), and the velocity-on, which describes how hard you press the key and ranges from 0 to 127 (with a value of zero resulting in a silence).

Note Off message: This message is sent when you release the key of the controller. Its function is to terminate the note that was triggered with a Note On message. The same result can be achieved by sending a Note On message with its velocity set to 0, a technique that can help to reduce the stream of MIDI data. It contains the velocity-off parameter, which registers how hard you released the key (note that this particular information is not used by most MIDI controllers at the moment).

Aftertouch (pressure): This is a specific MIDI message that is sent after the Note On message. When you press a key of a controller, a Note On message is generated and sent

to the MIDI OUT port. This is the message that triggers the sound on the receiving device. If you push a little bit harder on the key after hitting it, an extra message, called *Aftertouch*, is sent to the MIDI OUT of the controller. The *Aftertouch* message is usually assigned to control the vibrato effect of a sound, but, depending on the patch that is receiving it, it can also affect other parameters, such as volume, pan, and more.

There are two types of *aftertouch*: polyphonic and monophonic. Monophonic *aftertouch* affects the entire range of the keyboard no matter which key or keys triggered it. This is the most common type of *aftertouch*, and it is implemented on most (but not all) controllers and MIDI synthesizers available on the market. Polyphonic *aftertouch* allows you to send an independent message for each key. It is more flexible as only the intended notes will be affected.

Pitch bend: This message is controlled by the pitch-bend wheel on a keyboard controller. It allows you to raise or lower the pitch of the notes being played. It is one of the few MIDI data that do not have a range of 128 steps. In order to allow a more detailed and accurate tracking of the transposition, the range of this MIDI message extends from 0 to 16,383. Usually, a sequencer would display 0 as the center position (non-transposed), +8191 fully raised and -8192 fully lowered.

Program change: This message is used to change the patch assigned to a certain MIDI channel. Each synthesizer has a series of programs (also called patches, presets, instruments or, more generically, sounds) stored in its internal memory; for each MIDI channel we need to assign a patch that will play back all the MIDI data sent to that particular channel. This operation can be done by manually changing the patch from the front panel of the synthesizer, or by sending a program change message from a controller or a sequencer. The range of this message is 0 to 127. As modern synthesizers can store many more than 128 sounds, nowadays programs are organized into *banks*, where each bank stores a maximum of 128 patches. In order to change a patch through MIDI messages it is, therefore, necessary to combine a bank change message and a program change message. While the latter is part of the MIDI standard specification, the former changes depending on the brand and model of MIDI device. Most devices use CC#0 or CC#32 to change bank (or sometimes a combination of both), but you should refer to the synthesizer's manual to find out which MIDI message is assigned to bank change for that particular model and brand.

Control changes (CC): These messages allow you to control certain parameters of a MIDI channel. There are 128 CCs (0–127); that is, the range of each controller extends from 0 to 127. Some of these controllers are standard and are recognized by all the MIDI devices. Among the most important of these (because they are used more often in sequencing) are CC#1, 7, 10, and 64. CC#1 is assigned to modulation. It is activated by moving the modulation wheel on a keyboard controller. It is usually associated with a slow vibrato effect. CC#7 controls the volume of a MIDI channel from 0 to 127, while number 10 controls its pan. Value 0 is pan hard left, 127 is hard right and 64 is centered. Controller number 64 is assigned to the sustain pedal (the notes played are held until the pedal is released). This controller has only two positions: on (values > 64) and off (values < 63). While the four controllers mentioned above are the most commonly used, there are other controllers that can considerably enhance the MIDI rendition of acoustic instruments and the control that you have over the sound of your MIDI devices. Table 1.2 lists all 128 controllers with their specifications and their most common uses in sequencing situations.

Table 1.2 Control change (CC) messages

Controller #	Function	Usage
0	Bank select	Allows you to switch bank for patch selection. It is sometimes used in conjunction with CC#32 to send bank numbers higher than 128
1	Modulation	Sets the modulation wheel to the specified value. Usually this parameter controls a vibrato effect generated through a low-frequency oscillator (LFO). It can also be used to control other sound parameters such as volume in certain sound libraries
2	Breath controller	Can be set to affect several parameters, but usually is associated with aftertouch messages
3	Undefined	
4	Foot controller	Can be set to affect several parameters, but usually is associated with aftertouch messages
5	Portamento value	Controls the rate used by portamento to slide between two subsequent notes
6	Data entry (MSB)	Controls the value of either registered (RPN) or non-registered (NRPN) parameters
7	Volume	Controls the volume level of a MIDI channel
8	Balance	Controls the balance (left and right) of a MIDI channel. It is mostly used on patches that contain stereo elements (such as stereo patches): 64 = center, 127 = 100% right, and 0 = 100% left
9	Undefined	
10	Pan	Controls the pan of a MIDI channel: 64 = center, 127 = 100% right, and 0 = 100% left
11	Expression	Controls a percentage of volume (CC#7)
12	Effect controller 1	Mostly used to control the effect parameter of one of the internal effects of a synthesizer (e.g., the decay time of a reverb)
13	Effect controller 2	Mostly used to control the effect parameter of one of the internal effects of a synthesizer
14–15	Undefined	
16–19	General purpose	These controllers are open and they can be assigned to aftertouch or similar messages
20–31	Undefined	
32–63	LSB for control 0–31	These controllers allow you to have a “finer” scale for the corresponding controllers 0–31
64	Sustain Pedal	Controls the sustain function of a MIDI channel. It has only two positions: off (values between 0 and 63) and on (values between 64 and 127)
65	Portamento on/off	Controls whether the portamento effect (slide between two consequent notes) is on or off. It has only two positions: off (values between 0 and 63) and on (values between 64 and 127)

(continued)

8 Acoustic and MIDI Orchestration for the Contemporary Composer

Table 1.2 (continued)

Controller #	Function	Usage
66	Sostenuto on/off	Similar to the sustain controller, but holds only the notes that are already turned on when the pedal was pressed. It is ideal for the “chord hold” function, where you can have one chord holding while playing a melody on top. It has only two positions: off (values between 0 and 63) and on (values between 64 and 127)
67	Soft pedal on/off	Lowers the volume of the notes that are played. It has only two positions: off (values between 0 and 63) and on (values between 64 and 127)
68	Legato footswitch	Produces a legato effect (two subsequent notes without pause in between). It has only two positions: off (values between 0 and 63) and on (values between 64 and 127)
69	Hold 2	Prolongs the release of the note (or notes) playing while the controller is on. Unlike the sustain controller (CC#64), the notes won’t sustain until you release the pedal, but instead they will fade out according to their release parameter
70	Sound controller 1	Usually associated with the way the Synthesizer produces the sound. It can control, for example, the sample rate of a waveform in a wavetable synthesizer
71	Sound controller 2	Controls the envelope over time of the voltage-controlled filter (VCF) of a sound, allowing you to change over time the shape of the filter. It is also referred to as “resonance”
72	Sound controller 3	Controls the release stage of the voltage-controlled amplifier (VCA) of a sound, allowing you to adjust the sustain time of each note
73	Sound controller 4	Controls the attack stage of the VCA of a sound, allowing you to adjust the time that the waveform takes to reach its maximum amplitude
74	Sound controller 5	Controls the filter cutoff frequency of the VCF, allowing you to change the brightness of the sound
75–79	Sound controller 6–10	Generic controllers that can be assigned by a manufacturer to control non-standard parameters of a sound generator
80–83	General purpose controllers	Generic button-switch controllers that can be assigned to various on/off parameters, they have only two positions: off (values between 0 and 63) and on (values between 64 and 127)
84	Portamento control	Controls the amount of Portamento
85–90	Undefined	
91	Effect 1 depth	Controls the depth of effect 1 (mostly used to control the reverb send amount)
92	Effect 2 depth	Controls the depth of effect 2 (mostly used to control the tremolo amount)
93	Effect 3 depth	Controls the depth of effect 3 (mostly used to control the chorus amount)

Table 1.2 (continued)

Controller #	Function	Usage
94	Effect 4 depth	Controls the depth of effect 4 (mostly used to control the celeste or detune amount)
95	Effect 5 depth	Controls the depth of effect 5 (mostly used to control the phaser effect amount)
96	Data increment (+1)	Mainly used to send an increment of data for RPN and NRPN messages
97	Data increment (-1)	Mainly used to send a decrement of data for RPN and NRPN messages
98	Non-registered parameter number (NRPN) LSB	Selects the NRPN parameter targeted by controllers 6, 38, 96, and 97
99	Non-registered parameter number (NRPN) MSB	Selects the NRPN parameter targeted by controllers 6, 38, 96, and 97
100	Registered parameter number (RPN) LSB	Selects the RPN parameter targeted by controllers 6, 38, 96, and 97
101	Registered parameter number (RPN) MSB	Selects the RPN parameter targeted by controllers 6, 38, 96, and 97
102–119	Undefined	
120	All sound off	Mutes all sounding notes regardless of their release time and regardless of whether the sustain pedal is pressed
121	Reset all controllers	Resets all the controllers to their default status
122	Local on/off	Enables you to turn the internal connection between the keyboard and its sound generator on or off. If you use your MIDI synthesizer on a MIDI network, most likely you will need the local to be turned off in order to avoid notes being played twice
123	All notes off	Mutes all sounding notes. The notes that are turned off by this message will still retain their natural release time. Notes that are held by a sustain pedal will not be turned off until the pedal is released
124	Omni mode off	Sets the device to omni off mode
125	Omni mode on	Sets the device to omni on mode
126	Mono mode	Switches the device to monophonic operation
127	Poly mode	Switches the device to polyphonic operation

Among the 128 control change (CC) messages available in the MIDI standard, there are a few that can be particularly useful in a sequencing and music production environment. In particular, certain CC messages can be extremely helpful in improving the realism of MIDI sonorities when used to reproduce the sounds of acoustic instruments. Let's take a look at the CC messages (and their functions) that are particularly helpful in these types of applications. In order to tackle so many control changes without being overwhelmed, they can be organized according to their function and simplicity. Here, we will start with the most basic and most commonly used messages, and end with the more advanced ones.

1.3.2 *Most commonly used control changes*

Among the most used CCs, there are four that, in one way or another, you will use even for the most basic sequencing projects. These CCs are volume (CC#7), pan (CC#10), modulation (CC#1), and sustain (CC#64). While their names and functions are basically self-explanatory, their advanced use can bring your projects and your MIDI orchestration techniques to another level. Let's take a look at each message individually.

Volume (CC#7) enables you to control the volume of a MIDI channel directly through the sequencer or MIDI controller. Like most of the MIDI messages, it has a range of 128 steps (from 0 to 127), with 0 indicating basically a mute state and 127 full volume. Keep in mind that this is not the only way to control the volume of a MIDI track (more on this later), but it is certainly the most immediate. Think of CC#7 as the main volume on the amplifier of your guitar rig. It controls the overall output level of a MIDI channel. Also keep in mind that, as is the case for most MIDI messages, the message is sent to a MIDI channel and not to a MIDI track, and you have one volume control per MIDI channel and not per track. Therefore, if you have several tracks (i.e., drums) sent to the same MIDI channel and MIDI cable, they will all share the same volume control. The more advanced sequencing techniques involving the use of CC#7 will be discussed later in the book.

Pan (CC#10) controls the stereo image of a MIDI channel. The range extends from 0 to 127, with 64 being panned in the center, 0 hard left and 127 hard right. As for CC#7, this message is sent to the MIDI channel and not to a specific track.

Modulation (CC#1) is usually assigned to vibrato, although in some cases can be assigned to control other parameters of a MIDI channel. For example, certain software synthesizers (e.g., Garritan Orchestra) use CC#1 to control the volume and sample switch of the instruments. This controller is a very flexible one and can, in fact, be used to manipulate several parameters that do not necessarily relate to vibrato. The way Modulation affects the sound depends on how the synthesizer patch is programmed.

Sustain (CC#64) is usually associated with the sustain pedal of a keyboard controller. By pressing the sustain pedal connected to your controller you send a CC#64 with value 127; by depressing the pedal, you send a value of 0. Whenever the MIDI channel receives a CC#64 with value 127 it will sustain the notes that were pressed at the moment the control message was sent, until a new message (this time with a value of 0) is sent to the same MIDI channel. The overall effect is the same as you would obtain by pressing the sustain pedal on an acoustic piano.

1.3.3 *Extended controllers*

In addition to the basic controllers described above, there is a series of extended controllers that allow you to manipulate other parameters of a MIDI channel in order to achieve a higher degree of flexibility when controlling a MIDI device. These are the messages that you will take more advantage of when trying to take your sequencing, MIDI orchestration and arranging skills to a higher level. They are particularly suited to adding more expressivity to such acoustic parts as string, woodwind, and brass tracks, as these instruments usually require a high level of control over dynamics, intonation, and color.

Let's take a look at the extended MIDI controllers that are available under the current MIDI specifications.

Breath controller (CC#2): This controller can be set by the user to affect different parameters; it is not tied to a specific operation. It is usually set to the same parameter controlled by aftertouch. Generally, you will find it programmed to control modulation, volume or vibrato. Breath controller is found mostly in MIDI wind controllers, where the amplitude of the controller is commanded by the pressure of the airflow applied to the mouthpiece.

Foot controller (CC#4): As in the case of the previous MIDI message, CC#4 can be assigned by the user to a series of parameters, depending on the situation. It can control volume, pan, or other specific parameters of a synthesizer. It is a continuous controller with a range of 0 to 127.

Portamento on/off (CC#65) and portamento time (CC#5): These give you control over the slide effect between two subsequent notes played on a MIDI controller. While CC#65 allows you to turn the portamento effect off (values 0–63) or on (values 64–127), with CC#5 you can specify the rate at which the portamento effect slides between two subsequent notes (0–127).

Balance (CC#8): This controller is similar to pan (CC#10). It controls the balance between the left and right channels for MIDI parts that use a stereo patch, while pan is more often used for mono patches. It ranges from 0 to 127, where a value of 64 represents a center position, 0 hard left and 127 hard right.

Expression controller (CC#11): This particular controller is extremely helpful, and often used to change the volume of a MIDI channel. While you might recall that CC#7 controls the volume of a MIDI channel, expression allows you to scale the overall volume of a MIDI channel by a percentage of the value set by CC#7. In practical terms, think of CC#7 as the main volume on the amplifier for your guitar, and CC#11 as the volume on your guitar. They both, in fact, have an impact on the final volume of the part (MIDI channel), but CC#11 allows you to fine-tune the volume inside the range set by CC#7. To clarify further, think about the following examples. If you set CC#7 of a MIDI channel to 100 and CC#11 for the same channel to 127, you will get a full volume of 100. Now think what happens if you lower CC#11 to 64 (128 divided by 2); now, your overall volume will be 50 (100 divided by 2). Thus, expression can be extremely useful if used in conjunction with CC#7. A practical application would be to do all your volume automation with the expression controller and use CC#7 to raise or lower the overall volume of your MIDI tracks. We will discuss the practical application of the expression controller in the following chapters.

Sostenuto on/off (CC#66): CC#66 is similar to CC#64. When sent by pressing a pedal, it holds the notes that were already On when the pedal was pressed. It differs, though, from the sustain message because the notes that are sent after the pedal is pressed won't be held, as they are in the case of CC#64. It is very useful for holding chords while playing a melody on top.

Soft pedal on/off (CC#67): This controller works exactly like the pedal found on an acoustic piano. By sending a CC#67 to a MIDI device/part it lowers the volume of any

notes played on a MIDI channel while the pedal is pressed. Soft pedal is off with values ranging from 0 to 63, and on with values from 64 to 127.

Legato footswitch (CC#68): This controller enables you to achieve a similar effect to the one used by wind and string players when playing two or more subsequent notes using a single breath or bow stroke. The legato effect achieved creates a smoother transition between notes. CC#68 achieves a similar effect by instructing the synthesizer to bypass the attack section of the voltage-controlled amplifier (VCA)'s envelope of the sound generator and, therefore, avoiding a second trigger of the notes played.

Hold (CC#69): CC#69 is similar to the sustain controller #64. While the latter sustains the notes being played until the pedal is released (values between 0–63), CC#69 prolongs the notes played by simply lengthening the release part of the VCA's envelope of the sound generator. This creates a natural release that can be used effectively for string and woodwind parts to simulate the natural decay of acoustic instrument sounds.

1.3.4 Coarse versus fine

All controllers from 0 to 31 have a range of 128 steps (from 0 to 127), as they use a single data byte to control the value part of the message. While most controllers do not need a higher resolution, for some applications there are other controllers that would greatly benefit from a higher number of steps in order to achieve a more precise control. For this reason, the MIDI standard was designed to have coarse and fine control messages. Each controller from 0 to 31 has a finer counterpart in controllers 32 to 63. By combining two data bytes [least significant byte (LSB) and most significant byte (MSB)], the values have a much greater range. Instead of the coarse 128 steps, the finer adjustments use a range of 16,384 steps (from 0 to 16,383) achieved by using a 14 bit system ($2^{14} = 16,384$). While this function is a valuable one, most often you will be using the traditional coarse setting, as not all MIDI devices are, in fact, programmed to respond to the finer settings.

1.3.5 Control your sounds

The controllers analyzed so far are targeted to generic parameters that mainly deal with pan, volume, and sustain. There is a series of controllers, though, that can go even further and give you control of other effects present on your MIDI synthesizer, such as reverb, chorus, tremolo, detune, attack and release time. Through the use of such powerful MIDI messages you can achieve an incredible realism when sequencing acoustic instruments. Let's take a look at this series of controllers.

Effect controllers 1 and 2 (CC#12 and 13): These two controllers allow you to change the parameters of an effect on a synthesizer. They are usually associated with the parameters of a reverb, such as reverb decay and size.

Sound controller 1—sound variation (CC#70): This controls the generator of the waveform on a synthesizer. One of the most common applications is the control of the sampling frequency of the generator, thereby altering the speed and "pitch" of the sound.

Sound controller 2—timbre/harmonic intensity (CC#71): This controls the shape of the voltage-controlled filter (VCF) of a synthesizer over time. It enables you to alter the brightness of the patch over time.

Sound controller 3—release time (CC#72): This controls the release time of the voltage-controlled amplifier (VCA) of a sound generator, giving you control over the release time of a patch on a particular MIDI channel. This message is very useful when sequencing acoustic patches, such as strings and woodwind, as it enables you to quickly adjust the patch for staccato or legato passages.

Sound controller 4—attack time (CC#73): This controller is similar to the one just described above. The main difference is that CC#73 gives you control over the attack parameter of the VCA of your sound generator. This is particularly indicated when sequencing acoustic instruments where different attack values can help you re-create more natural and realistic results. We will discuss specific techniques related to the practical applications of controllers later in this book.

Sound controller 5—brightness (CC#74): CC#74 controls the cutoff frequency of the filter for a given patch and MIDI channel. By changing the cutoff frequency you can easily control the brightness of a patch without having to tinker with the MIDI device directly. Once again, this message gives you extreme flexibility and control over the realism of your MIDI instruments.

Sound controller 6—decay time (CC#75): This often is used to control, in real time, the decay parameter of the VCA's envelope. Note that sometimes, depending on the MIDI device you are working with, CC#75–79 are not assigned to any parameter and, therefore, are undefined.

Sound controllers 7, 8, and 9—vibrato rate, depth, and delay (CC#76, 77, and 78): Using these controllers you can vary, in real time, the rate and depth of the vibrato effect created by the sound generator of a synthesizer. You can effectively use these MIDI messages to control the speed and amount of vibrato for a certain patch and MIDI channel. These controllers can be particularly useful in improving the realism of sequenced string, woodwind, and brass instruments for melodic and slow passages.

Sound controller 10—undefined (CC#79): CC#79, like a few other controllers, is not assigned by default to any parameter. It can be used by a manufacturer to control, if needed, a specific parameter of a synthesizer.

Effects depth 1 (CC#91): Controllers 91 through 95 are dedicated to effects parameters often associated with general MIDI devices. Through these messages you can interact with the depth of such effects. Think of these controllers almost as effect send levels for each MIDI channel. CC#91 is specifically targeted to control the depth of the built-in reverb effect of a synthesizer. While, for most professional productions, the use of built-in effects is fairly limited, for quick demos and low-budget productions, the ability to quickly control your reverb depth can sometimes be useful.

Effects depth 2 (CC#92): This enables you to control the depth of a second on-board effect of your synthesizer. It is often associated with the control of the depth of a tremolo effect, if available on your MIDI device.

Effects depth 3 (CC#93): This controls the send level of the built-in chorus effect on your synthesizer.

Effects depth 4 (CC#94): This enables you to control the depth of a generic on-board effect of your synthesizer. It is often associated with the control of the depth of a detune effect, if available on your MIDI device.

Effects depth 5 (CC#95): This enables you to control the depth of a generic on-board effect of your synthesizer. It is often associated with the control of the depth of a phaser effect, if available on your MIDI device.

1.3.6 Registered and non-registered parameters

In addition to the messages discussed so far, there is a series of parameter messages that expands the default 128 CC. These extended parameters are divided into two main categories: registered (RPN) and non-registered (NRPN). The main difference between the two categories is that the former includes messages registered and approved by the MIDI Manufacturers' Association (MMA), while the latter is open and doesn't require manufacturers to comply with any particular standard. The way both categories of messages work is a bit more complicated than the regular CC that we just discussed, but they provide users with an incredible amount of flexibility for their MIDI productions. Let's learn how they are constructed and used.

RPN messages—CC#101 (coarse), 100 (fine): RPN messages allow for up to 16,384 parameters to be controlled, as they use the coarse-fine system explained earlier by using a double 7-bit system. As you can see, this allows for a huge selection of parameters that can eventually be controlled in a synthesizer. At the moment, though, only seven parameters are registered with the MMA: pitch-bend sensitivity, channel fine tuning, channel coarse tuning, tuning program change, tuning bank select, modulation depth range and reset. RPN messages are based on a three-step procedure. First, you have to send CC#101 and 100 to specify the desired RPN that you want to control, according to the values shown in Table 1.3.

Table 1.3 RPN list

Parameter # CC#101	CC#100	Function	Comments
0	0	Pitch bend sensitivity	MSB controls variations in semitones; LSB controls variations in cents
0	1	Channel fine tuning	Represents the tuning in cents (100/8192) with 8192 = 440 Hz
0	2	Channel coarse tuning	Represents the tuning in semitones with 64 = 440 Hz
0	3	Tuning program change	Tuning program number (part of the MIDI tuning standard, rarely implemented)
0	4	Tuning bank select	Tuning bank number (part of the MIDI tuning standard, rarely implemented)
0	5	Modulation depth range	Used only in GM2 devices
0	127	Reset RPN/NRPN	Reset the current RPN or NRPN parameter

After specifying the RPN parameter, you then send the data part of the message through CC#6 (coarse) and, if necessary, CC#38 (fine). If you want to modify the current status of the parameter you can either resend the entire message with the new parameter data, or simply use the data increment messages CC#96 (+1) and CC#97 (−1).

NRPN messages—CC#99 (coarse), 98 (fine): A similar procedure can be used to send NRPN messages. The only difference is that these messages vary depending on the manufacturer and on the device to which they are sent. Each device responds to a different set of instructions and parameters, very much like system exclusives that are specific to a MIDI device.

1.3.7 Channel mode messages

This category includes messages that affect mainly the MIDI setup of a receiving device.

All notes off (CC#123): This message turns off all the notes that are sounding on a MIDI device. Sometimes it is also called the “panic” function, since it is a remedy for “stuck notes”, MIDI notes that were turned on by a Note On message but that, for some reason (data dropout, transmission error, etc.), were never turned off by a Note Off message.

Local on/off (CC#122): This message is targeted to MIDI synthesizers. These are devices that feature keyboard, MIDI interface and internal sound generator. The “local” is the internal connection between the keyboard and the sound generator. If the local parameter is on, the sound generator receives the triggered notes directly from the keyboard, and also from the IN port of the MIDI interface (Figure 1.3). This setting is not recommended in a sequencing/studio situation, as the sound generator would play the same notes twice, reducing its polyphony (the number of notes the sound generator can play simultaneously) by half. It is, though, the recommended setup for a live situation in which the MIDI ports are not used. If the local parameter is switched off (Figure 1.4), the sound generator receives the triggered notes only from the MIDI IN port, which makes this setting ideal for the MIDI studio. The local setting usually can also be accessed from the “MIDI” or “General” menu of the device, or can be triggered by CC#122 (0–63 is off, 64–127 is on).

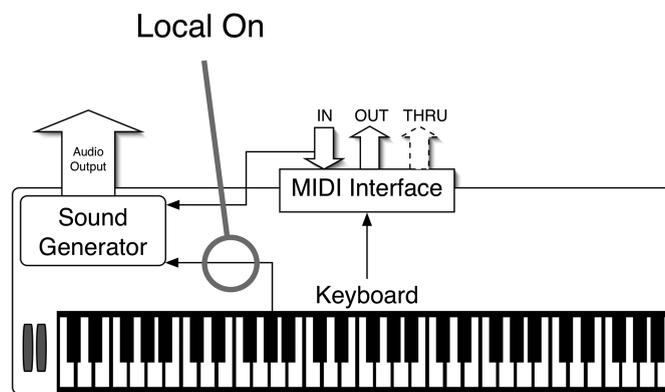


Figure 1.3 Local on.

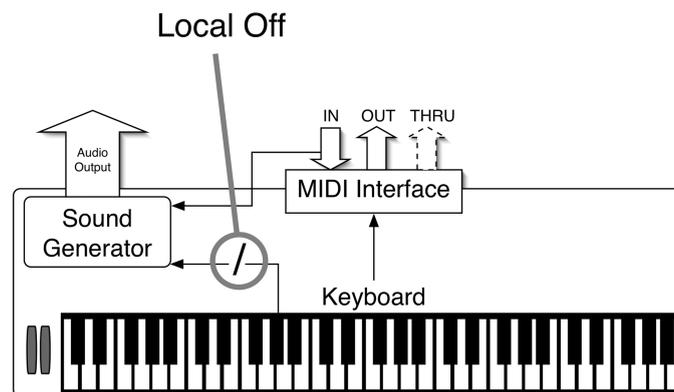


Figure 1.4 Local off.

Poly/mono (CC#126, 127): A MIDI device can be set as polyphonic or monophonic. If set up as poly, the device will respond as polyphonic (able to play more than one note at the same time); if set up as mono, the device will respond as monophonic (able to play only one note at a time per MIDI channel). The number of channels can be specified by the user. In the majority of situations we will want to have a polyphonic device, in order to take advantage of the full potential of the synthesizer. The poly/mono parameter is usually found in the “MIDI” or “General” menu of the device, but it can also be selected through CC#126 and CC#127, respectively.

Omni on/off (CC#124, 125): This parameter controls how a MIDI device responds to incoming MIDI messages. If a device is set to omni on, it will receive on all 16 MIDI channels but it will redirect all the incoming MIDI messages to only one MIDI channel (the current one) (Figure 1.5). If a device is set to omni off, it will receive on all 16 MIDI channels, with each message received on the original MIDI channel to which it was sent (Figure 1.6). This setup is more often used in sequencing, as it enables one to take full advantage of the 16 MIDI channels on which a device can receive. Omni off can also be selected through CC#124, while omni on is selected through CC#125.

All sound off (CC#120): This is similar to the “all notes off” message, but it doesn’t apply to notes that are being played from the local keyboard of the device. In addition, this message mutes the notes immediately, regardless of their release time and whether the hold pedal is pressed.

Reset all controllers (CC#121): This message resets all controllers to their default states.

1.3.8 System real-time messages

Real-time messages (like all other system messages) are not sent to a specific channel as are the channel voice and channel mode messages, but instead are sent globally to the MIDI devices in your studio. These messages are used mainly to synchronize all the MIDI devices in your studio that are clock based, such as sequencers and drum machines.

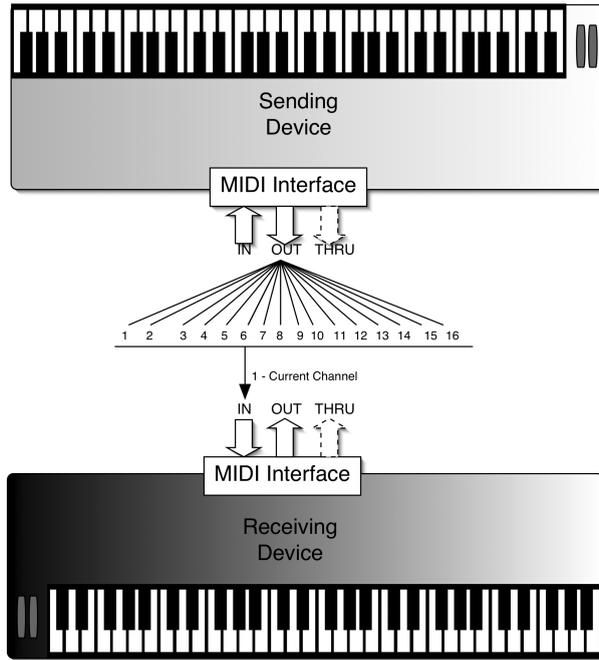


Figure1.5 Omni on.

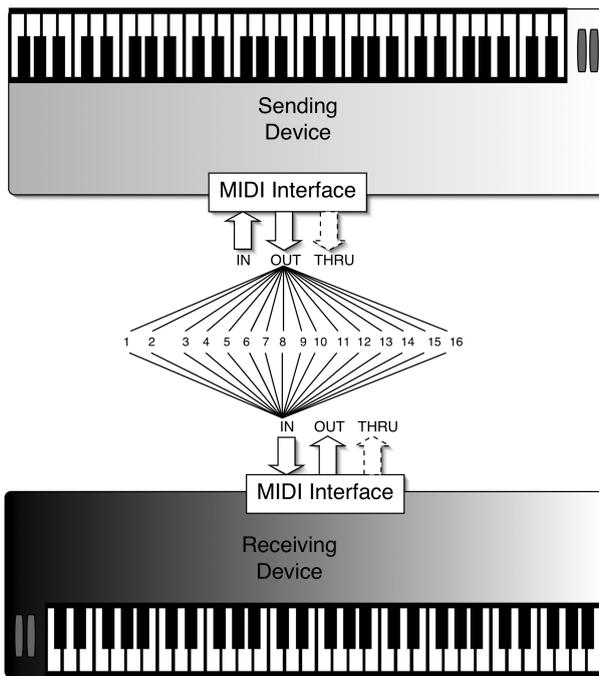


Figure1.6 Omni off.

Timing clock: This is a message specifically designed to synchronize two or more MIDI devices that must be locked into the same tempo. The devices involved in the synchronization process need to be set up in a master–slave configuration, where the master device (sometimes labeled as “internal clock”) sends out the clock to the slave devices (“external clock”). It is sent 24 times per quarter note and, therefore, its frequency changes with the tempo of the song (tempo based). It is also referred to as MIDI clock, or sometimes as MIDI beat clock.

Start, continue, stop: These messages allow the master device to control the status of the slave devices. “Start” instructs the slave devices to go to the beginning of the song and start playing at the tempo established by the incoming timing clock. “Continue” is similar to “start”, with the only difference being that the song will start playing from the current position instead of from the beginning of the song. The stop message instructs the slave devices to stop and wait for either a start or a continue message to restart.

Active sensing: This is a utility message that is implemented only on some devices. It is sent every 300 ms or less, and is used by the receiving device to detect if the sending device is still connected. If the connection were interrupted for some reason (e.g., the MIDI cable were disconnected), the receiving device would turn off all its notes to avoid causing “stuck” notes.

System reset: This restores the receiving devices to their original power-up conditions. It is not commonly used.

1.3.9 System common messages

System common messages are not directed to a specific channel, and are common to all receiving devices.

MIDI time code (MTC): This is another syncing protocol that is time based (as opposed to MIDI clock, which is tempo based). It is mainly used to synchronize non-linear devices (such as sequencers) to linear devices (such as tape-based machines). It is a digital translation of the more traditional SMPTE code used to synchronize non-linear machines. The format is the same as SMPTE. The position in the song is described in hours:minutes:seconds:frames (subdivisions of one second). The frame rates vary depending on the format used. If you are dealing with video, the frame rate is dictated by the video frame rate of your project. If you are using MTC simply to synchronize music devices, it is advisable to use the highest frame rate available. The frame rates are 24, 25, 29.97, 29.97 drop, 30, and 30 drop.

Song position pointer: This message tells the receiving devices to which bar and beat to jump. It is mainly used in conjunction with the MIDI clock message in a master–slave MIDI synchronization situation.

Song select: This message allows you to call up a particular sequence or song from a sequencer that can store more than one project at the same time. Its range extends from 0 to 127, thus allowing for a total of 128 songs to be recalled.

Tune request: This message is used to retune certain digitally controlled analog synthesizers that require adjustment of their tuning after hours of use. This function does not apply to most modern devices, and is rarely used.

End of system exclusive: This message is used to mark the end of a system exclusive message, which is explained in the next section.

1.3.10 System exclusive messages (SysEx)

System exclusives are very powerful MIDI messages that allow you to control any parameter of a specific device through the MIDI standard. SysEx are specific to each manufacturer, brand, model, and device and, therefore, cannot be listed here as we have the generic MIDI messages described so far. In the manual of each of your devices there is a section in which all the SysEx messages for that particular model of device are listed and explained. These messages are particularly useful for parameter editing purposes. Programs called *editors/librarians* use the computer to send SysEx messages to connected MIDI devices in order to control and edit their parameters, making the entire patch editing procedure much simpler and faster.

Another important application of SysEx is the MIDI data bulk dump. This feature enables a device to send system messages that describe the internal configuration of that machine and all the parameters associated with it, such as patch/channel assignments and effects setting. These messages can be recorded by a sequencer connected to the MIDI OUT of the device and played back at a later time to restore that particular configuration, making it a flexible archiving system for the MIDI settings of your devices.

1.4 Principles of orchestration

Having reviewed the MIDI standard and its messages, it is time now to review the principles of orchestration in order to gain an overall comprehensive view of the variables involved in the acoustic realm of arranging. This is crucial in order to bring your MIDI orchestration skills to a higher level. Writing and sequencing for MIDI instruments is no different than writing and orchestrating for acoustic ensembles. All the rules that you must follow for an acoustic ensemble apply to a MIDI sequence. Often one of the biggest problems that I encounter when assessing some of my colleagues and students' MIDI productions is the lack of classical and traditional orchestration skills that, no matter how sophisticated your MIDI equipment is, should never be overlooked. In the following paragraphs Richard DeRosa will guide you through the main concepts and terms that constitute the fundamentals of orchestration.

1.4.1 Composition

The first stage of a musical creation is, of course, composing. This occurs most often at a piano. The piano provides the ultimate palette since it encompasses the complete range of musical sound and is capable of demonstrating the three basic textures of musical composition: monophonic texture (melody), polyphonic texture (multiple melodies occurring simultaneously) and homophonic texture (harmony).

Arranging

The second stage of the process is arranging. At this point, the factors under consideration may be the addition of an introduction or an ending, as well as any transitional material. Some new melodic ideas may be added that would serve as counterpoint to the original melody. Sometimes there are harmonic concerns such as the need to choose a specific key or create a modulation.

Orchestration

The third and final stage requires the assignment of individual parts to various instruments. This process involves an acute awareness of instrumental color, weight, balance and intensity, as well as physical practicalities. The ultimate artistic goal is to flesh out the mood and expression of the composition.

There are composers who are comfortable with all three procedures and many prefer to do all three when time permits. Today, composers are usually obligated to create a mock performance of the orchestrated composition/arrangement so the client has an idea of what the final result will be with real instruments. Of course, many situations dictate the need economically to have the final product exist in the MIDI format. Whatever the case, it will help greatly to have a traditional understanding of orchestration in order to enhance the MIDI representation.

Traditional orchestration

Orchestration, in the traditional sense, is the process of writing for the instruments of a full orchestra. There are four distinct groups within the ensemble that are characterized as follows: strings, woodwinds, brass, and percussion. The broader definition of orchestration essentially means to write for any combination of instruments. There is the wind ensemble, concert band, marching band, woodwind quintet, brass quintet, string quartet, jazz ensemble, also known as a big band, and a multitude of chamber groups that are comprised of a variety of instruments.

1.4.2 Range

Every instrument has a certain span of notes that it can play. This is referred to as the range of the instrument. Usually the bottom of the range is fixed but, quite often, the upper end of the range can be extended in accordance with the abilities of the individual performer. Within an instrument's range there is a portion that is used most commonly because it is the most flexible in ability and expression. This is referred to as the *practical range*.

It is most beneficial when the orchestrator can stay within this range without compromising the artistic integrity of the composition and/or arrangement. This is especially true for the commercial composer (music for recording sessions or live concerts) because of the time constraints involved in rehearsing music. In today's world there is very little time to prepare music, for several reasons. Studio time is very expensive (there is the cost of the studio, the engineer, an assistant, the musicians, the conductor, etc.) so it is advantageous

parameters of the overtone series are not respected, the end result could be an unclear or a muddy presentation (Figure 1.8).

Using the series as a guide it can be determined that within the first octave only an interval of a perfect octave will be resonant. Henceforth, any other interval within this 1st octave (contrabass register) will be unclear. Moving to the second octave, it can be determined that, in addition to the interval of a perfect octave, the perfect 5th and perfect 4th intervals may be used. Only in the third octave can the orchestrator begin to arrange chord voicings. In accordance with the overtone series, at this point the major and minor 3rds are heard clearly. (Other intervals emerge when considering non-adjacent notes; there is the tritone located within the notes E–B \flat ; there is also the minor 7th located between the notes C and B \flat , as well as the inversion of these notes B \flat –“middle” C located at the top of this octave, creating the interval of a major 2nd.)

“Middle” C (named as such because it is found exactly in the middle of the keyboard and also, on staff paper, directly between the treble and bass clef staves) marks the beginning of the fourth octave. This location serves as an aural boundary defining the fundamental harmonic region (below this point) and the extended harmonic region (above this point). Please remember that this characteristic serves merely as a guideline. As with all music creativity there is always a certain amount of flexibility regarding the arrangement of notes within a voicing.

The chord in Figure 1.9 is derived from most of the notes of the overtone series as it is heard from the note C. It creates a dominant 13th with an augmented 11th. Notice that there is only one chord tone in the first octave (in this case, the root). In the second octave, along with the root, there is the 5th of the chord. (This is why instruments in the bass register play roots and 5ths. This is apparent in music such as a Sousa march, ragtime, and Dixieland jazz.) In the third octave the chord color increases with the emergence of the 3rd and 7th. In the fourth octave the upper or extended chord tones emerge. The D is heard as a major 9th, the F# is heard as the augmented 11th and the A is heard as the major 13th of the chord.

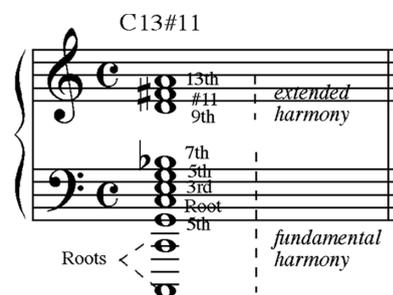


Figure 1.9 Overtone series chord.

In jazz, there is an abundant usage of extended harmony and it is imperative that the arranger/orchestrator understand how to organize harmonic structures within the guidelines provided by the overtone series. Modern classical music (found often in film scoring) also demands careful attention to this principle.

1.4.4 Transposition

Many instruments require the need to transpose. This is because instruments are made in various sizes and, owing to the inherent physical qualities, larger objects will sound lower than smaller ones. The following analogy should help the reader to understand this aspect. Imagine blowing into three empty bottles: small, medium and large. The effect will be that the smallest bottle will offer the highest pitch. The medium-size bottle will offer a pitch lower than the small bottle but its pitch will also be higher than the largest bottle. The same principle applies to instruments of any type: drums, saxophones, string instruments, etc.

Using the saxophone family as an example, there are four types of saxophone that are used most commonly today. They are the soprano sax, alto sax, tenor sax, and baritone sax. Each saxophone has the same set of “fingerings” (button combinations needed to create various pitches). This makes it quite easy for a sax player to perform on any of the saxes. The problem occurs for the orchestrator because he or she cannot simply write the notes from the piano and give them to the saxophonist, or the result will be that the music will be heard in a different key. This situation becomes worse if two different Saxophonists (i.e. an alto and tenor sax) were to play the same set of written notes. The result would be that each saxophone is heard in its respective key, creating an undesirable effect of polytonality (music heard simultaneously in two different keys).

1.4.5 Concert instruments

It is important to know that there are also instruments that do not require any transposition. In this case the instrument *sounds as written*. This also means that the instrument sounds at the same pitch as the piano. These instruments are said to be in *concert pitch* with the piano and are more commonly referred to as instruments in C.

1.4.6 Transposing instruments

There are three types of transposition that may be employed. They are *pitch*, *register* and/or *clef* transposition. The following four instruments will demonstrate the need for these various transpositions:

Clarinet in B \flat : Because this instrument is tuned in the key of B \flat , it requires a *pitch transposition*. If the clarinetist were to play the note C it would actually sound as the note B \flat on the piano. To compensate for this differential the clarinetist would need to play one whole tone higher. In other words, the clarinetist would play a D so that it sounds in unison with the C played on the piano (illustration provided in Chapter 4).

Double bass: Many low instruments (and high ones too) require a *register transposition*. This is a bit more arbitrary as it supports the need to simplify the note-reading process. The bulk of the bass’s range exists well below the bass clef staff and would require an excessive amount of leger lines. To bypass this problem, it was decided that all bass parts should be written an octave higher. As a result, the reading of music becomes much simpler since most of the notes now lie within the bass clef staff (illustration provided in Chapter 3).

Guitar: The guitar is similar to the double bass as it uses a register transposition of an octave. However, guitarists read only treble clef (at least we must assume so in accordance with tradition). Most of the notes found on the guitar lie within the bass clef staff, so a conversion to treble clef is necessary (illustration provided in Chapter 2).

Baritone saxophone: This instrument actually requires the use of all three transpositions. Pitched in the key of E \flat , it sounds a major 6th lower, along with a register transposition of an octave, when it plays the note C. Since saxophonists read only in treble clef, the clef transposition must take place as well (illustration provided in Chapter 4).

1.4.7 *Weight, balance, and intensity*

As an instrument passes through its range the dynamic contour (volume of sound) can change. Some instruments are thicker and fuller in the bottom range. Others become thinner near the bottom. The opposite effect can occur in other instruments. Some instruments are naturally softer than others and vice versa. As a result, the balance may be affected and it is the job of the orchestrator to know how to maintain good balance with the instruments. The intensity of an instrument's timbre is determined by how rapidly the vibrations move within the sound, as well as the physical energy required by the performer.

Using a violin, a flute, and a trumpet to demonstrate the difference, imagine that all three instruments were, in unison, playing a high concert E located on the third leger line above the treble staff. The violinist uses the least amount of energy since there is no breath support needed. The sound of the string actually becomes thinner since there is less string length. (This is why many violins are needed in an orchestra in order to maintain balance with the stronger woodwind and brass.) The flautist needs to support the note with a significant amount of breath. The timbre of this note is quite bright but not shrill and it penetrates rather nicely. The trumpeter needs an exorbitant amount of energy to play this note and many trumpet players cannot even accomplish this. To capture specific pitches on a brass instrument, beyond the specific valve or slide positions, the performer must use air in combination with embouchure (the mouth's position against the mouthpiece) support. The trumpet in this register is exceedingly powerful and would certainly outbalance the other two instruments.

It is imperative that the orchestrator keeps in mind the physical endurance of the performers. Excessively long musical passages without places to breathe or constant playing in the high register will be detrimental to the performance and, in some cases, may be impossible to execute.

1.4.8 *Hazards of writing at the piano*

As mentioned previously, the piano offers the best palette from which to create. However, there are some distinct pitfalls that can lead astray a novice orchestrator. The *piano offers only one timbre*, so the blend and balance of pitches within a harmonic structure occurs naturally. If the orchestrator is writing for a string section then the transfer from the piano to the string section will be fairly true. The same can be said for a section of trombones or any other type of instrumentation that offers a monochromatic timbre. However, if the performing group were a woodwind quintet (flute, oboe, clarinet, bassoon, and French horn), the final presentation of sound would be very different from what is heard initially

at the piano. In this scenario the orchestrator must be keenly aware of the distinct timbral color differences in addition to the factors of weight, balance, and intensity.

The *factors of breathing and endurance are missing* when playing a piano. This of course is not a concern if the performers are playing instruments that do not require breath support, but if the instrumentation is for a brass group these factors are of critical importance.

Technical difficulties are different on other instruments. Wide leaps in quick succession may be difficult on brass instruments. Complex melodies with difficult chromatic tones can be more challenging for string players. (In general, it is more difficult for string players to play in tune since the pitches on string instruments are not fixed as they are on the piano.) A piano piece is not so easily performed on the harp since the harp is set up as a diatonic instrument. (In order to play chromatically, the harpist must implement pedal changes. The pedals are found at the bottom on either side of the strings and obviously two pedal changes on one side would take longer than changing two pedals simultaneously on opposite sides of the strings.) Mute changes in brass instruments and equipment changes in the percussion section are other factors that must be considered.

Tonal capability varies according to instrument. The orchestrator cannot simply write loud or soft on the part and expect the performer to produce the desired effect. The orchestrator must know what is the general capability of an instrument before assigning a specified dynamic level. It is analogous to trying to force a car to go faster than what is the capability of its engine or trying to lift an amount of weight beyond what is humanly possible.

There is *no sustain pedal* in an orchestra. The orchestrator must be keenly aware of this and establish sustain within the instruments (more commonly referred to as "pads") by actually writing out the specific duration of each sustained passage.

Voice-leading is not as apparent at the piano. The orchestrator should not simply "take the notes from top to bottom" and assign them accordingly to the corresponding instruments. This may seem logical but, in fact, can expose a novice orchestrator since the end result may produce unfavorable musical results in the form of incorrect or awkward voice-leading. (For example, an oboe and a clarinet have two distinct sounds. If the orchestrator were to simply assign in an obvious way the notes for these instruments from the original sketch conceived at the piano, each instrument might expose an unfavorable or unmelodic resolution.) This phenomenon only becomes apparent as a result of the two distinct timbres. At the piano, the voice-leading (or lack thereof) goes unnoticed since all of the notes are colored with the same timbre.

The physical context of performance at the piano is ultimately quite different from the reality of performance by a multitude of individuals on various instruments. At the piano the monophonic texture (melody) is usually played in the right hand and the homophonic texture (harmony) is played in the left hand. Imagine hearing the melody played only by the violins, flutes, and trumpets, never the French horns, cellos or bassoons. This would deny the wider spectrum of expression that music is capable of. Quite often, the wonderful aspect of polyphonic texture (multiple melodic ideas) is omitted because of the physical constraints of performance at the keyboard. Sometimes, when using polyphony, the lines to be played by different instruments may cross. This is quite acceptable and even interesting, especially when each line is represented by a distinct instrumental color. At the piano, this possibility might not be considered since it is usually awkward physically to cross the melodic lines.

Generally, in the case of a complex orchestration, it will probably be impossible to “perform” all of the parts at the piano. For the music arranger/orchestrator, the piano is viewed primarily as a tool that can guide the writing process. It is sometimes easier for non-pianists to adopt this line of thinking and more difficult for the pianist to think outside of what is his or her normal performance domain. For the modern music writer, the advantage of realizing the process via MIDI helps that writer to think beyond the limited scope of what the piano keyboard has to offer.

1.5 Final considerations

The secret to a professional-sounding and realistic contemporary production is the right combinations of traditional orchestration techniques and advanced sequencing tools and skills. Only by mastering the two aspects of modern production are you able to bring the quality of your work to another level. In order to do so, in this chapter, we first analyzed the basic tools and concepts that form the backbone of a MIDI studio, for you to have a full grasp of the environment in which you will be working. This is a crucial aspect of contemporary MIDI orchestration since having a fully functional, versatile, and flexible project studio is a key element. Knowing the tools that are available to you as a MIDI orchestrator is extremely important in order to be able to achieve any sonority or effect you want in your composition. We don't want to settle only for the known features of your sequencer or your MIDI studio, but instead we want to explore more advanced techniques, commands, and controllers in order to be able to create the perfect MIDI rendition of your scores. You should always keep a copy of the extended MIDI controllers list handy in your studio. It would be a bit intimidating to memorize them all, therefore have a copy of Table 1.2 available next to you or on your computer. Always remember that the tools that you use to create your music are exactly that, tools. Try not to be caught in the middle of a technological struggle that would get in the way of your creativity. The purpose of this book is precisely to help you avoid technological “breakdowns” that would stop your creativity. My advice: learn the tools, set your studio in an efficient and streamlined way and then let the creative process flow!

Most people are not musicians and therefore listen to music from a different perspective. Primarily, music speaks to the listener more from the standpoint of emotion and expression than technique. It is most important for the music creator to respect this and remember that live musicians will also experience music this way. The orchestrator must respect the physical laws of sound as they relate to the overtone series along with the range, registers, and tonal colors of the various instruments as there is a direct connotation to expression. Technique is only what is used to facilitate and enhance the overall presentation.

In the next chapters we are going to analyze specific sections of the modern large ensemble. For each chapter we will analyze the traditional orchestration techniques first, in order to give you the necessary background you need to understand ranges, transposition, styles, and combinations of each instrument that is part of a specific section. Once you are familiar with the more traditional techniques you will be ready to move on to learn and experiment with the advanced MIDI techniques used to render your parts within the realm of a MIDI studio, using extended MIDI controllers, automation, mixing techniques and more.

1.6 Summary

Almost all contemporary music productions are based on a hybrid combination of acoustic instruments and MIDI parts. To be able to master both aspects of the production process is crucial for the modern composer and orchestrator. To understand the MIDI standard is extremely important for a successful and smooth production process. The MIDI standard is based on 16 independent channels on which MIDI data are sent and received by the devices. On each channel a device can transmit messages that are independent of the other channels. Every device that needs to be connected to a MIDI studio or system must have a MIDI interface. The MIDI standard uses three ports to control the data flow: IN, OUT, and THRU. While the OUT port sends out MIDI data generated from a device, the IN port receives the data. The THRU port is used to send out an exact copy of the messages received from the IN port. Depending on the type of MIDI interface (single cable or multi-cable) you get for your computer and sequencer, you can have, respectively, two main MIDI configurations: daisy-chain (DC) or star network (SN). The DC setup is more limited and it is mainly used in simple studio setups or live situations where a computer is (usually) not used. The SN setup allows you to take full advantage of the potential of your MIDI devices. One of the big advantages of the star network setup is that it allows one to use all 16 MIDI channels available on each device, as the computer is able to redirect the MIDI messages received by the controller to each cable separately.

The messages of the MIDI standard are divided into two main categories: channel messages and system messages. Channel messages are further subdivided into channel voice and channel mode messages, while system messages are subdivided into real-time, common and system exclusive messages. Channel voice messages carry information about the performance; for example, which notes we played and how hard we pressed the trigger on the controller. In this category the control change messages are among the most used when it comes to MIDI orchestration and sequencing because of their flexibility and comprehensive coverage. These messages allow you to control certain parameters of a MIDI channel. There are 128 CCs (0–127); that is, the range of each controller extends from 0 to 127. Among the 128 control change (CC) messages available in the MIDI standard, there are a few that can be particularly useful in a sequencing and music production environment. In particular, some CC messages can be extremely helpful in improving the realism of MIDI sonorities when used to reproduce the sounds of acoustic instruments. Among the most used CCs, there are four that, in one way or another, you will use even for the most basic sequencing projects. These CCs are volume (CC#7), pan (CC#10), modulation (CC#1), and sustain (CC#64). In addition to these basic controllers, there is a series of extended controllers that allow you to manipulate other parameters of a MIDI channel in order to achieve a higher degree of flexibility when controlling a MIDI device. They are particularly suited to adding more expressivity to such acoustic parts as string, woodwind, and brass tracks, as these instruments usually require a high level of control over dynamics, intonation, and color. All controllers from 0 to 31 have a range of 128 steps (from 0 to 127), as they use a single data byte to control the value part of the message. While most controllers do not need a higher resolution, for most applications there are other controllers that would greatly benefit from a higher number of steps in order to achieve more precise control. For this reason, the MIDI standard was designed to have coarse and fine control messages. Each controller from 0 to 31 has a finer counterpart in controllers 32 to 63.

The channel mode messages include messages that affect mainly the MIDI setup of a receiving device, such as all notes off (CC#123), local control on/off (CC#122), poly on/mono on (CC#126, 127), omni on/off (CC#124, 125), reset all controllers (CC#121), and all sound off (CC#120).

Real-time messages (like all other system messages) are not sent to a specific channel as are the channel voice and channel mode messages, but instead are sent globally to the MIDI devices in your studio. These messages are used mainly to synchronize all the MIDI devices in the studio that are clock based, such as sequencers and drum machines. System common messages are not directed to a specific channel, and are common to all receiving devices. They include MTC, song position pointer, song select, tune request, and end of system exclusive.

System exclusives are very powerful MIDI messages that allow you to control any parameter of a specific device through the MIDI standard. SysEx are specific to each manufacturer, brand, model, and device and, therefore, cannot be listed here as we have the generic MIDI messages described earlier. These messages are particularly useful for parameter editing purposes.

1.7 Exercises

Exercise 1.1

Connect the MIDI equipment shown in Figure 1.10 in a daisy-chain setup.

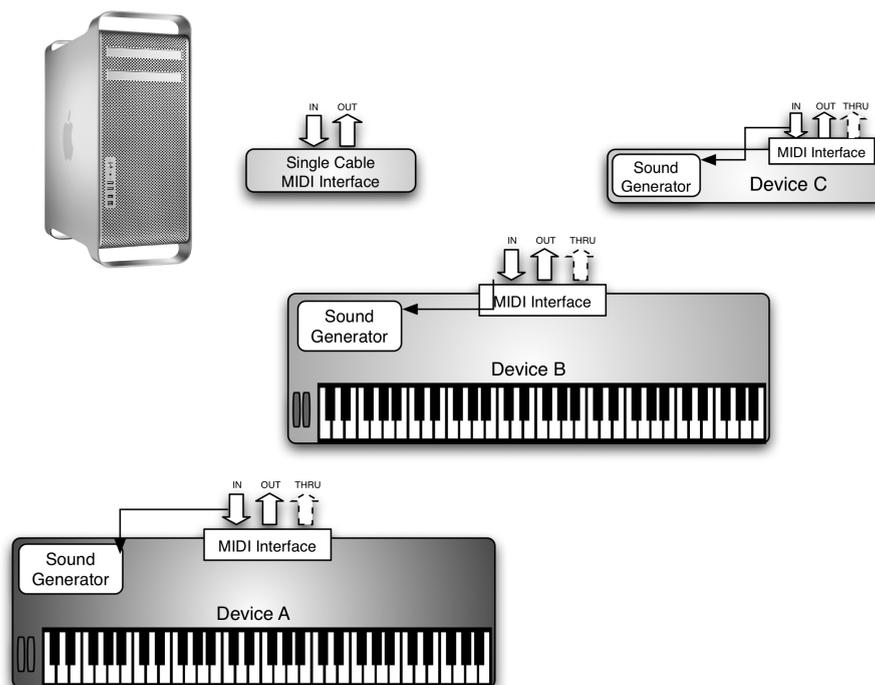


Figure 1.10 (Courtesy of Apple Inc.)

Exercise 1.2

Connect the MIDI equipment shown in Figure 1.11 in a star network setup.

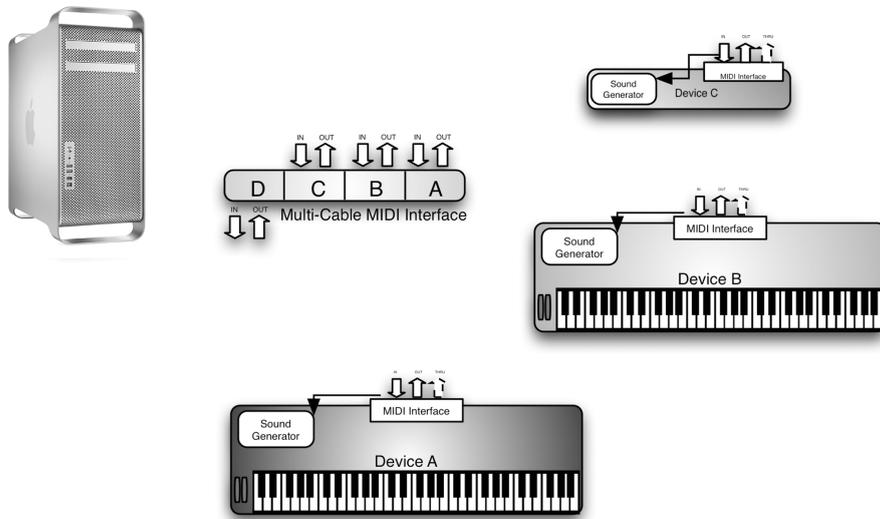


Figure 1.11 (Courtesy of Apple Inc.)

Exercise 1.3

Give a brief description of the following MIDI CCs:

CC#	Description
1	
2	
7	
10	
11	
64	
65	

Exercise 1.4

Give a brief description of the following MIDI messages:

MIDI message	Description
Note On	
Monophonic aftertouch	
Polyphonic aftertouch	
Pitch bend	
Control change	
Program change	

Exercise 1.9

Transpose the piano accompaniment written in Figure 1.14 up an octave and written only in treble clef for guitar.

The figure shows two staves of music. The top staff is labeled "Gtr." and is in treble clef with a key signature of two sharps (F# and C#) and a common time signature (C). It contains four empty measures. The bottom staff is labeled "Piano" and is in bass clef with the same key signature and time signature. It contains four measures of piano accompaniment. The first measure has a quarter rest followed by a quarter note G2, an eighth note F#2, and an eighth note G2. The second measure has a quarter note G2, an eighth note F#2, and an eighth note G2. The third measure has a quarter note G2, an eighth note F#2, and an eighth note G2. The fourth measure has a quarter note G2, an eighth note F#2, and an eighth note G2. All notes in the piano part are beamed together and have a slur over them.

Figure 1.14**Exercise 1.10**

Transpose the melody written in Figure 1.15 up an octave and a major 6th for baritone saxophone (remember to use only the treble clef).

The figure shows two staves of music. The top staff is labeled "(pno.)" and is in bass clef with a key signature of two flats (Bb and Eb) and a common time signature (C). It contains four measures of piano melody. The first measure has a quarter rest followed by a quarter note G2, an eighth note F#2, and an eighth note G2. The second measure has a quarter note G2, an eighth note F#2, and an eighth note G2. The third measure has a quarter note G2, an eighth note F#2, and an eighth note G2. The fourth measure has a quarter note G2, an eighth note F#2, and an eighth note G2. All notes in the piano part are beamed together and have a slur over them. The bottom staff is labeled "Baritone sax" and is in treble clef. It contains four empty measures.

Figure 1.15