

# Foundations of Music Technology

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## Chapter 4 ~ Synthesis

- **Additive Synthesis** ~ Type of synthesis in which waves are summed to create new timbres. When referring to audio, for example, the harmonic series can be expressed as a function by which a simple sine wave oscillating at a fundamental frequency can be multiplied by numbers to produce additional waves called overtones. The sum of the fundamental frequency and its overtones produces a synthesized collection of waves, which are summed at the output and perceived as a single timbre.
- **ADSR/ADSR Envelope** ~ Attack, decay, sustain, release sound profile that describes how the sound evolves for some time.
- **All Pass Filter** ~ Type of audio filter in which “all” frequencies received at the input are permitted to “pass” through the output.
- **Amplitude Modulation (AM) Synthesis** ~ Type of synthesis by which waves are multiplied together to produce new timbres. The amplitude of one wave, known as the carrier, is determined by the amplitude of another wave, known as the modulator, which dips up and down at some rate of the modulator’s frequency. The amplitude of the modulator signal is controlled differently than in the AM synthesis variant ring modulation.
- **Attack Time** ~ Elapsed time it takes for the initial onset of sound to reach its peak before it begins to decay.
- **Bandpass Filter** ~ Type of audio filter in which specific groups or “bands” or frequencies received at the input are permitted to “pass” through the output.
- **Beating/Beat Interference** ~ Sonic phenomenon resulting from the interference between two similar frequencies. The phenomenon produces an effect similar to tremolo.
- **Bins** ~ Resultant samples from performing an FFT on a signal.
- **Breakpoint Function** ~ Various points in a curve such as the attack, decay, sustain, and release points in an ADSR envelope.
- **Carrier/Carrier Signal** ~ In modulation synthesis, the carrier is the signal that has some property changed by the modulator signal.
- **Carrier/Modulator Ratio** ~ In FM synthesis, the frequency value of the carrier signal as it relates to the modulator signal expressed as a ratio.
- **Comb Filter** ~ In audio, a type of filter in which signals are delayed and introduced back into the signal in order to produce feedback; a process that causes certain frequencies to resonate.

- **DC Offset** ~ In audio recording, an instance where the mean value of the amplitude is a nonzero number as a result of the recording process, commonly a positive number. The correction of removing DC offset recenters the waveform around 0.
- **Decay Time** ~ In an ADSR curve, the time between the point when the initial attack ends and the sustain begins.
- **Envelope** ~ The “shape” of the sound as it relates to timbre. It is associated with ADSR curves, which determine how the sound evolves for some time. Aspects of the envelope may also be expressed in a so-called breakpoint function in which multiple points are used to represent aspects of the motion of a sound’s properties over time.
- **Equalization (EQ)** ~ The process of “tone-shaping” through the use of level controls applied to specified bands of the audible spectrum. For example, a three-band EQ would divide the audible spectrum into low-, mid-, and high-frequency bands and use a control to adjust the level of each group of banded frequencies.
- **Fast Fourier Transform (FFT)** ~ In audio, a process by which the Fourier transform is carried out on a sound or signal resulting in the discretizing of individual waves from a complex waveform. When referring to audio, for example, running an FFT on a sound can reveal information about the frequencies present in the sound, which can be plotted graphically. In general, an FFT is useful in transferring information about a signal from the time domain to the frequency domain.
- **Filter** ~ In audio, a process by which some feature present in the sound is removed, be it a band of frequencies, a specific frequency, or some other quality.
- **Fourier Transform** ~ This is a special process that is used to convert from the “time domain” to the “frequency domain.”
- **Frames** ~ Tiny slices of an audio file.
- **Frequency Modulation (FM) Synthesis** ~ Type of synthesis by which waves are multiplied together to produce new timbres. Specifically, the frequency of one wave, known as the carrier, is changed, or “modulated,” by changing the frequency of another wave, known as the modulator. When referring to audio, the wave modulation of FM synthesis produces distorted and bell-like timbral effects that are rich in overtones.
- **Grains** ~ In granular synthesis, tiny slices of recorded audio that are manipulated in the synthesis process.
- **Granular Synthesis** ~ Type of synthesis by which small slices of a recorded waveform are manipulated to produce new timbres. When referring to audio, the size of the small slices of a recorded sound, referred to as grains, are played, looped, and manipulated to produce “clouds” of sound.

- **Highpass Filter** ~ Type of audio filter in which specific groups or “bands” of frequencies received at the input are permitted to “pass” through the output.
- **Karplus-Strong String Synthesis** ~ In synthesis, an algorithm that produces a plucked string sound derived from modeling existing plucked string instruments.
- **Low-Frequency Oscillation (LFO)** ~ Slow-moving frequency, usually between 20 and 100 Hz, that is used to change timbral qualities of another frequency or sound source. When referring to audio, the timbral change is usually perceived as vibrato (changes to a wave’s pitch) or tremolo (changes to a wave’s amplitude). LFOs are particularly useful for adding expressivity to synthesized sounds.
- **Modulation** ~ In synthesis, the nature of changing one signal’s properties by way of another signal.
- **Modulator/Modulator Signal** ~ In synthesis, the signal that acts as an independent variable and changes the properties of a carrier signal.
- **Phase** ~ In phase difference, the time between two identical waves. When referring to audio, the phase effect produces a jet engine sound as the amount of time between the start of two identical sounds is shifted.
- **Physical Modeling** ~ In audio, a process by which a computer is used to represent aspects of a sound source by analyzing the sonic properties of the sound source and reconstructing a model to replicate the properties. The process of physical modeling involves analyzing every aspect of the sound source, such as the way sound reflects and emanates from every direction of a piano including from the lid, under the lid, off of the legs, and so on. A physical computer model can allow some aspects of the instrument, such as its playable range, to be expanded beyond the physical size of the instrument.
- **Pink Noise** ~ In audio, a noise source similar to white noise with different spectral qualities and a perceived low-pass filter when compared to white noise.
- **Q (Band Shape)** ~ In audio, the width of the band for a group of frequencies.
- **Release Time** ~ In an ADSR curve, the amount of time a sound takes to reach silence after the sustain portion.
- **Ring Modulation** ~ A simple implementation of amplitude modulation by which two signals are multiplied together. The amplitude of one wave, known as the carrier, is determined by the amplitude of another wave, known as the modulator, which dips up and down at some rate of the modulator’s frequency.
- **Sample-Based Synthesis** ~ In audio, the process by which recorded files, or samples, are played back to emulate the realistic sounds of acoustic instruments.

- **Sidebands** ~ In synthesis, frequencies that occur higher and lower than a center frequency, often known as the carrier frequency. When referring to audio, for example, the nature of frequency modulation (FM) synthesis creates sideband frequencies that surround the carrier frequency as a result of multiplying waves.
  - **Subtractive Synthesis** ~ Type of synthesis by which frequencies from a sound source or complex waveform are “filtered out” or removed to produce a new timbre. When referring to audio, a subtractive synthesizer may start with a white noise clip as its initial sound and use equalization, or EQ, techniques to change the timbral qualities of the sound.
  - **Sustain Volume** ~ In an ADSR curve, the level at which a sound is held until it begins to decay.
  - **Tremolo** ~ Process by which the amplitude of a wave is varied at some periodic rate. When referring to audio, a tremolo produces an effect where the volume of a sound appears to slowly duck in and out at some rate. It should not be confused with vibrato, where fluctuations in pitch occur instead of amplitude.
  - **Vibrato** ~ In audio, an effect by which the perceived pitch of a signal is changed at some periodic rate.
  - **Waveform** ~ Examples include sine waves, sawtooth wave, triangle wave, and square wave.
  - **Wavetable Synthesis** ~ In synthesis, an approach that uses a stored set of values that represent what an instrument waveform looks like instead of combining individual sine waves.
  - **White Noise** ~ In audio, a noise source consisting of the presence of all frequencies in a spectrum.
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## **Chapter 5 ~ MIDI**

- **Bank** ~ In MIDI devices, a bank typically holds a number of presets.
- **Controller**
- **Controller Number (MIDI)**
- **Controller/Continuous Control (MIDI)** ~ In MIDI, CC messages are reserved for transmitting performance messages like “bank select,” “modulation,” “volume,” and “pan” changes, and so on.
- **General MIDI** ~ Formalized standard for the MIDI protocol specification.
- **Keyboard Synthesizer**
- **Latency** ~ In audio recording, the amount of delay a system unintentionally introduces at the recording or playback stage, usually the result of computer processing resource limitations.
- **MIDI In** ~ In MIDI, the input port of a MIDI device for receiving MIDI data from controllers and other MIDI devices from the MIDI output port of other MIDI devices.
- **MIDI Out** ~ In MIDI, the output port of a MIDI device for sending MIDI data from controllers and other MIDI devices to the MIDI input port of other MIDI devices.
- **MIDI Thru** ~ In MIDI, the thru port of a MIDI device that typically duplicates the information received at the MIDI In port and passes the information “thru” without altering it.
- **Musical Instrument Digital Interface (MIDI)** ~ Protocol that computers use to convey musical messages using numbers. When referring to audio, for example, the numbers 0–127 are commonly used to represent musical concepts like pitch and dynamics.
- **Note Off Message (MIDI)** ~ In MIDI, messages that specify the MIDI pitch value being performed and a velocity value of 0 in order to cease a note from sounding.
- **Open Sound Control (OSC)** ~ Protocol like MIDI that conveys information about musical events and more with the potential for greater bandwidth than MIDI.
- **Patch/Program** ~ In MIDI, a sound module may organize preset instrument timbres into patches or programs within a bank of sounds.
- **Piano Roll Editor (MIDI)** ~ In DAWs, a graphical representation of MIDI notes vertically according to pitch and horizontally according to duration.
- **Port** ~ In audio equipment, a jack or connection input type designed to receive signals from connected cables.
- **Program Change (MIDI)** ~ In MIDI, the change from one General MIDI sound set timbre to another. Like other MIDI data, General MIDI program changes are numbered between 0 and 127.

- **Sampler** ~ Device used to play back recorded sound files known as samples. A sampler may also include the option to record samples. Samplers may be hardware or software based. There are software samplers that contain large libraries of prerecorded sample audio files. A sampler then plays these samples back when control messages are received from a DAW, a MIDI keyboard, or some other input.
  - **Software Synthesizer**
  - **Synthesizer** ~ Device that facilitates synthesis. In most cases a synthesizer has controls like keyboard keys, knobs, and buttons to manipulate parameters in the synthesis process.
  - **Sound Module** ~ In MIDI, a device by which MIDI data is synthesized into an audio signal.
  - **Virtual Instrument Software** ~ In audio recording, a software-based synthesizer module by which MIDI data is realized.
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## **Chapter 6 ~ Music Notation Software**

- **MusicXML** ~ In music notation software, a type of universal protocol for conveying notated information like pitches, dynamics, and even some musical markings.
  - **Type 0 MIDI File** ~ In MIDI, files in which all instrument tracks have been merged into a single MIDI channel.
  - **Type 1 MIDI File** ~ In MIDI, files in which multiple instrument tracks are stored on different MIDI channels.
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## **Chapter 7 ~ Sequencing MIDI**

- **Beats Per Measure (BPM)** ~ With regard to tempo, the number of beats that occur in each measure as related to the pulse of the performance.
  - **Clip (Live Software)** ~ In Live, an audio file that may be played back.
  - **Loop** ~ In audio, a prerecorded or precomposed pattern of audio or MIDI data intended to be repeated for compositional purposes, similar to ostinatos in the traditional sense.
  - **Quantization** ~ In MIDI, process of “smoothing” MIDI data by repositioning notes to the nearest beat division.
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## **Chapter 10 ~ Sequencing and Performing with Audio**

- **Bleed** ~ In recording, the nature of unintended audio to come through a particular microphone.
  - **Overdubbing** ~ In audio, process of layering recorded audio on top of previously recorded audio.
  - **Ping Pong Delay** ~ In audio, a type of delay effect by which delayed sounds are sent to multichannel speakers.
  - **Scene (Live)** ~ In Live, a scene represents an array of audio clips posted for playback.
  - **Stereo Pair** ~ In audio, two speakers used to play back stereo audio.
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