ELEKTRONISCHE MUSIK AND SOUND SYNTHESIS

Serialism

Serialism was first developed by Arnold Schoenberg in the early 1920's. It is a method of composition whereby all 12 notes of the equal tempered scale are organised in a fixed permutation/order/series. The piece of music is then constructed entirely out of this series, or closely related variations such as retrograde (reversed) or inversion (flipped upside down)[1].

Composers then extended this techniques to elements other than pitch, such as rhythms and timbre, and eventually began to control all of these elements using serialism simultaneously, and this became known as **total serialism**[2].

Elektronische Musik

Elektronische Musik, was a term originally coined by the German's **Werner Meyer-Eppler**, **Herbert Eimert**, and **Bobert Beyer**, to describe their approach to creating electronic music (obviously it translates as 'electronic music') in the early 1950's (so shortly after the creation of the first pieces of *Musique Concrète*).

Elektronische Musik differed from *Musique Concrète* on 2 fundamental levels:

(1) All of the sounds were to be created by electronic oscillators (Additive Synthesis) and noise generators (Subtractive Synthesis), i.e.:

- They were striving to create entirely **new** sounds, not use sounds from the real world

(2) All of the sounds were organised using **total serialism**, i.e.:

- *Elektronische Musik* pieces began as an abstract plan, and then the sounds were created to achieve this plan (remember in *Musique Concrète* the music was abstracted from the sounds themselves).

Karlheinz Stochausen (who had worked with Pierre Schaefer at the RTF studio in Paris) is probably the most famous of the *Elektronische Musik* composers. He expanded **total serialism**

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[1] http://www.oxfordmusiconline.com.ezproxy.lib.ucalgary.ca/subscriber/article/grove/music/25459?q=serialism&search=quick&pos=1&_start=1#firsthit

[2] http://www.oxfordmusiconline.com.ezproxy.lib.ucalgary.ca/subscriber/article/grove/music/25459?q=serialism&search=quick&pos=1&_start=1#firsthit

even further, using serial techniques to control dynamics, densities, and amplitude, and also using different tunings - for example his *Studie II* divides an octave and a major third (16 semitones) into 25 equal divisions!

Additive Synthesis

In Additive Synthesis, sounds are create by **combining** (i.e. adding) together a number of **different** sine waves, each with a different frequency and amplitude. As more and more sine tones are combined the sound gets more complex.

Subtractive Synthesis

In Additive Synthesis, we typically begin with **white noise**, or some other signal with a **rich spectrum** of frequencies, and then use filters to **remove** frequencies we do not want.

Amplitude Modulation (AM) synthesis

In AM synthesis, one oscillator (the **modulator**) is used to change the **amplitude** of another (the **carrier**). If the frequency of the modulator is less than the lower limit for human hearing (i.e. < 20Hz) this sounds like **tremolo** - i.e. smooth variations in **amplitude**. Once the frequency of the modulator goes above the lower limit for human hearing we get AM synthesis - this is also how *Ring Modulators* work.

Frequency Modulation (FM) synthesis

In FM synthesis, one oscillator (the **modulator**) is used to change the **frequency** of another (the **carrier**). If the frequency of the modulator is less than the lower limit for human hearing (i.e. < 20Hz) this sounds like **vibrato** - i.e. smooth variations in **pitch**. Once the frequency of the modulator goes above the lower limit for human hearing we get FM synthesis..

Granular Synthesis

In Granular Synthesis complex sounds are created by combining numerous **grains** (tiny portions, less than 100ms) of sound. This can be achieved by first dividing a sound into grains and rearranging/redistributing them, or by creating one grain (for example 100ms of a sine wave) and having multiple instances of that one sound play at different pitches, different positions, different lengths etc. This technique usually results in "clouds" of sound...

Timeline and musical examples

1928 - Leon Theremin patents the *Theremin*

1928 - Maurice Martenot invents the *Ondes Martenot*

1945-48 - Hugh le Caine built the *Electronic Sackbut* - earliest voltage controlled synthesiser

1951 - First broadcast on *Elektronische Musik* organised by **Werner Meyer-Eppler**, **Herbert Eimert**, and **Bobert Beyer** on Westdeutschen Rundfunks (WDR) in Cologne

1953 - *Studio für Elektronische Musik des Westdeutschen Rundfunks (WDR)* opens in Cologne[1, 100]

1953 - **Karlheinz Stockhausen** *Studie I* (Additive Synthesis)

* 1954 - **Karlheinz Stockhausen** *Studie II* (Additive Synthesis)

1955 - RCA Mark I Sound Synthesizer

1956 - **Louis and Bebe Barron** *Forbidden Planet Soundtrack* (first completely electronic soundtrack for a film)

1957 - RCA Mark II Sound Synthesizer

1957 - **Daphne Oram** develops *Oramics* system (converts drawing into sound)

1961 - *San Francisco Tape Music Center (SFTMC)*[3]

1963 - Don Buchla built the *Buchla Series 100* modular synthesiser[4] for composers at the *SFTMC*

1964 - **Milton Babbitt** *Ensembles for Synthesiser* (completely serial, made with RCA Mark II)

1964 - Bob Moog built first *Moog Modular* synth[5]

1967 - **Morton Subotnick** *Silver Apples of the Moon* (all Buchla Synthesisers, *SFTMC* composer)

1967 - **John Chowning** uses Frequency Modulation to create complex timbres (**FM synthesis**)

1968 - **Wendy Carlos** *Switched on Bach* (J.S. Bach compositions on Moog synthesisers)[6]

* 1968 - **Morton Subotnick** The Wild Bull (Buchla Synth)

1969 - Electronic Music Studio release - EMS VCS3

1973 - **Pink Floyd** *On The Run* (EMS VCS3)

1973 - **Paul Lansky** *mild und leise* (all FM) — Later sampled by **Radiohead** *Idioteque* (2000)

1974 - **Isao Tomita** *Snowflakes Are Dancing* (Claude Debussy compositions on Moog synths)

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[3] http://www.mortonsubotnick.com/timeline.html
[4] http://www.buchla.com/history/
[5] http://www.moogmusic.com/legacy/moog-product-timeline
[6] http://freemp3now.net/catalog/Wendy+Carlos%20-%20Air+On+A+G+String+%2528Switched-On+Bach%2529+1968

1974 - **_Kraftwerk_** _Autobahn_

1977 - **John Chowning** _Stria_ (all FM synthesis)

1978 - **Parliament** _Flashlight_ (actually not entirely synthesised, but a massive influence on the development of _Techno_)

1980's - **Roland** TB-303, TR-606, TR-808, TR-909... (all used on thousands of pieces)

1980's - Derrick May, Juan Atkins, & Kevin Saunderson (**Belleville Three**) - birth of _Techno_

1983 - Yamaha DX7 - digital **FM** synthesiser (also used on thousands of pieces)

* 1985 - **Paul Lansky** _Idle Chatter_

* 1986 - **Barry Truax** _Riverrun_ (Granular Synthesis - all sine tones)

Late 80's/Early 90's - 'Rave' culture peaks[2]

1992 - _Artificial Intelligence_ - compilation album released on _Warp_ records, including _Aphex Twin_, _Autechre_, _Richie Hawtin_, and more...

1998 - **Boards of Canada** _Music Has the Right to Children_

2001 - **Aphex Twin** _Vordhosbn_

2004 - **Venetian Snares** _Huge Chrome Cylinder Box Unfolding_

2010 - **Autechre** _Oversteps_

2011 - _Oramics_ iPhone app

Other Resources:

Daphne Oram Documentary

Documentary on the History of Electronic Dance Music

Roland TR-808 TR-909 TB-303 Documentary

Loads of other Documentaries about Electronic Music

REFERENCES

[1] Thom Holmes. _Electronic and experimental music: technology, music, and culture_. Routledge, 2012.

[2] Simon Reynolds. _Energy Flash: A Journey Through Rave Music and Dance Culture_. Faber & Faber, 2013.