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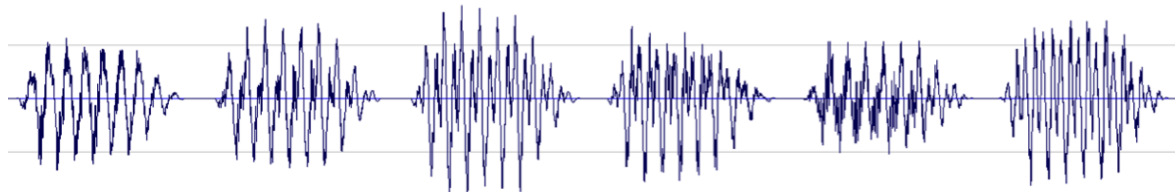
LAC - Paper presentation:
Combining frequency modulation with granular synthesis

Kim Ervik

Øyvind Brandsegg

Granular synthesis

"Synthesising sound based on adding thousand of sonically grains into larger acoustical events"



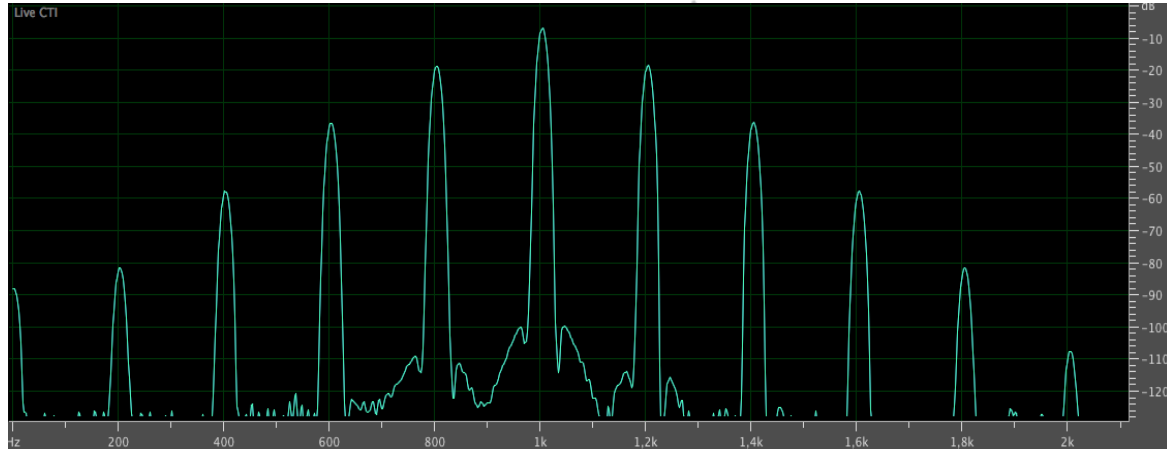
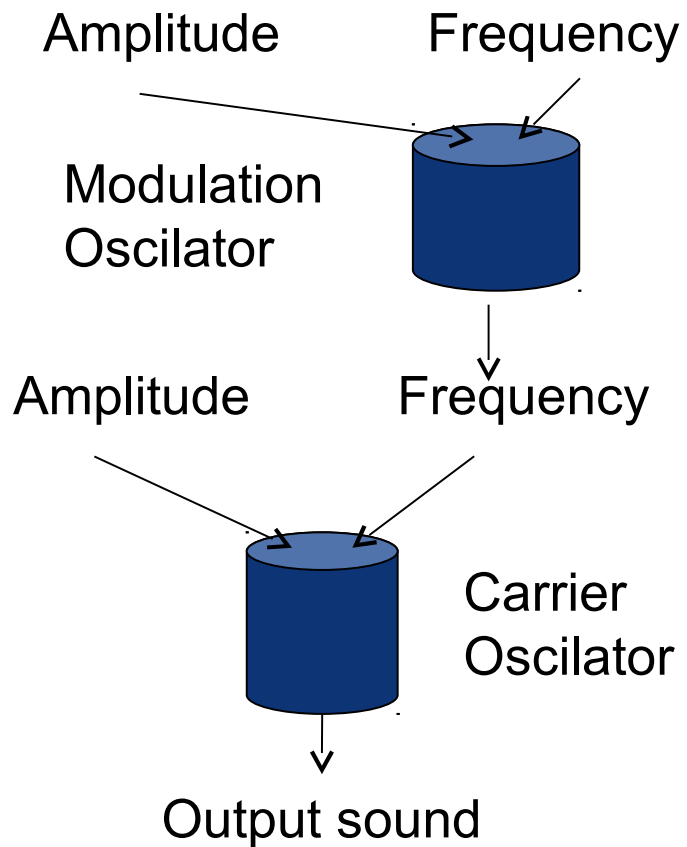
Application

- Independent time and pitch scaling
- Analog synth modeling
- Sound design and sound manipulation
- Granular reverbs and delay effects



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FM synthesis



$$f_n = f_c \pm n f_m$$

Modulation frequency = Carrier frequency * Ratio

Modulation amplitude = Modulation frequency * Index



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Pitch in GS

- Grain rate > 30 = Grain rate
- Grain rate < 30 = Grain pitch*

* With some exceptions. For instance if the phase or the reading position of the grain source is modulated, the pitch may be defined by the pitch of the content in the grains. Another exception is if the grain stream is asynchronous. Then the result will be noisy dependent on the random range of the grain distribution.



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Pitch in FM

- FM ratio 0,5: Percieved pitch one octave bellow
- FM ratio 7/8: Defuse fundamental pitch



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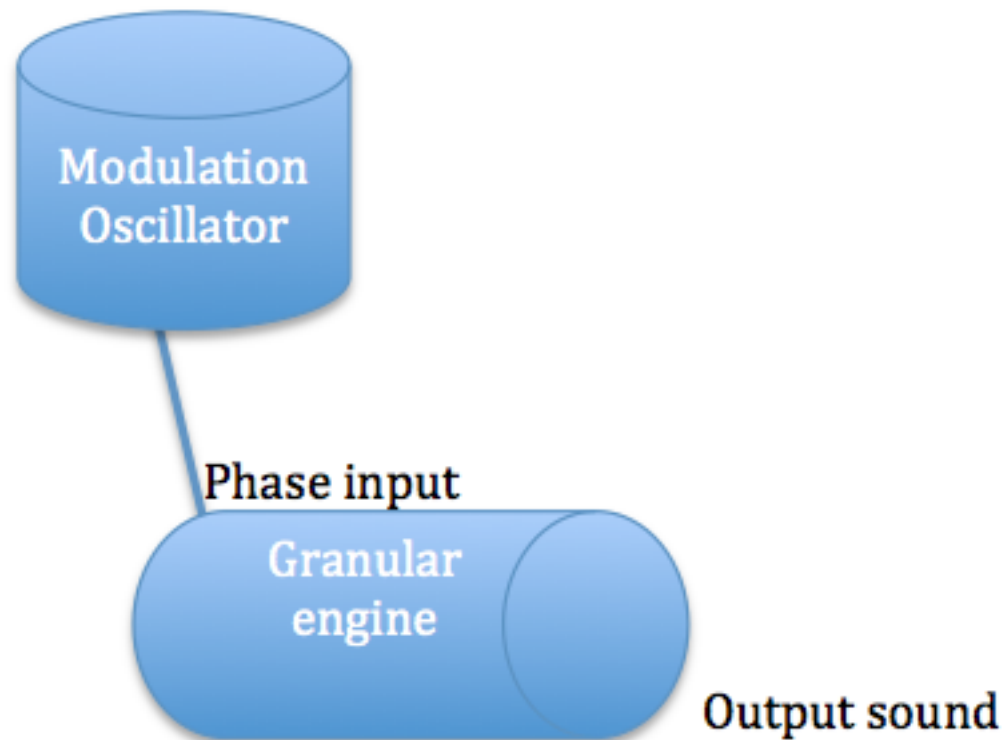
FM in granular synthesis

- Grain pitch modulation
- Grain rate modulation



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Grain pitch modulation



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Grain pitch modulation

Modulation frequency < 30 Hz

- Grain rate < 30 Hz: Vibrato
- Grain rate > 30 Hz: Periodical spectral sweeps
- Transition area (20 – 50 Hz) for both modulation frequency and grain rate



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Grain pitch modulation

Modulation frequency > 30 Hz

- FM index
- Harmonics of Granular synthesis dominates
- Sidebands emerge from a sub harmonic at 0 Hz



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Grain pitch modulation

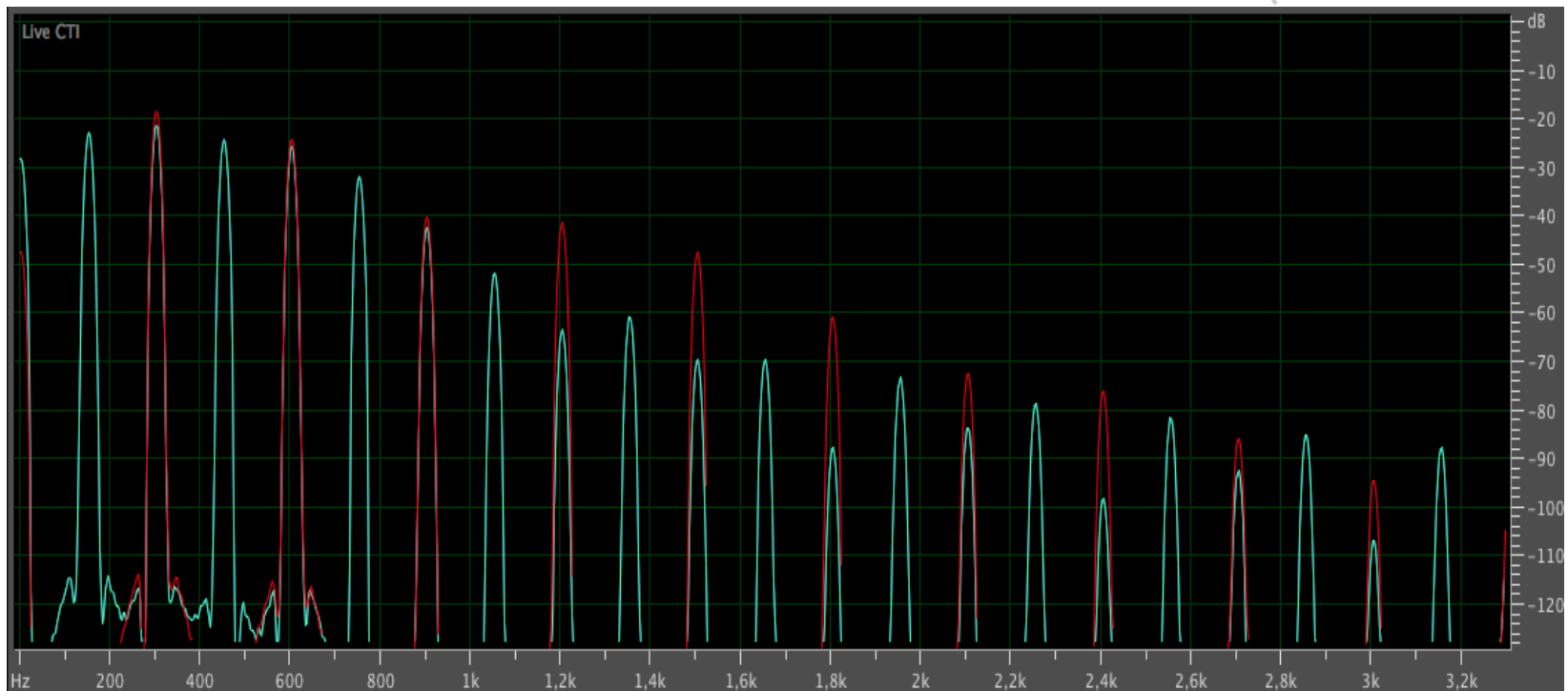


Grain rate: 300 - Grain pitch: 300 - Mod Ratio: 3



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Grain pitch modulation

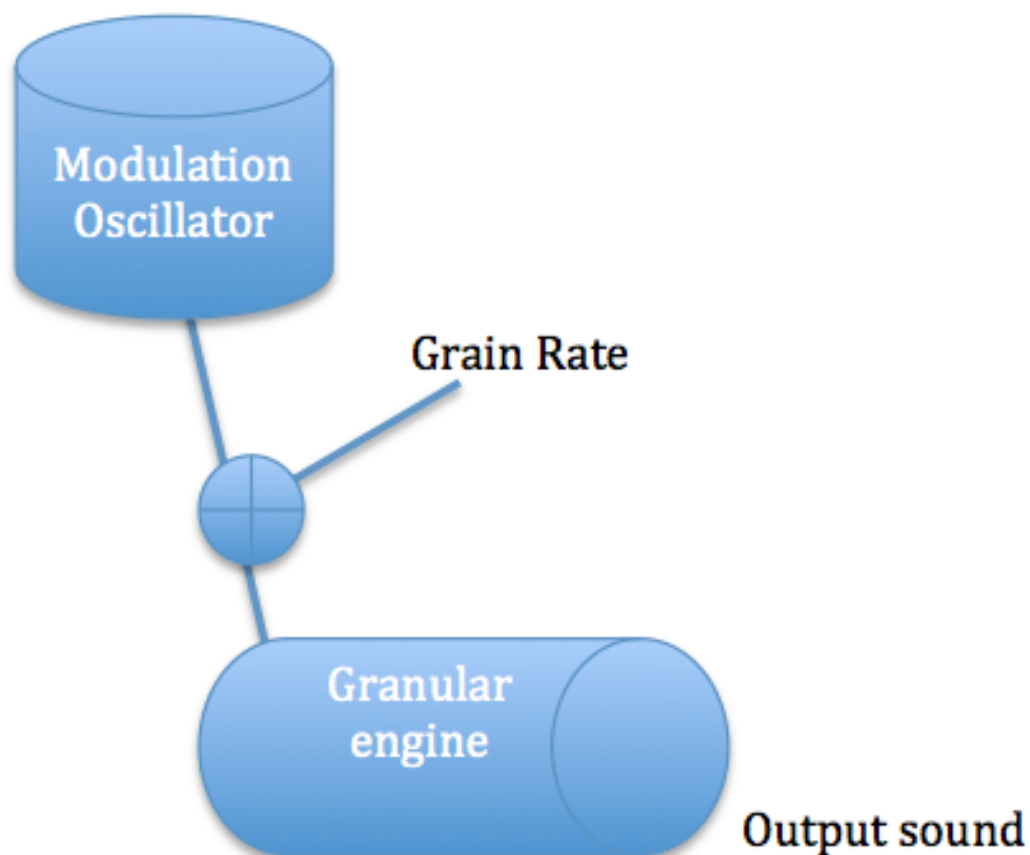


Grain rate: 300 - Grain pitch: 300 - Mod Ratio: 0.5



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Grain rate modulation



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Grain rate modulation

- Modulation index > 1
- Modulation index is a measurement of grain displacement within $\frac{1}{\text{grain rate}}$ Seconds



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Grain rate modulation

- Harmonics from the grain rate in granular synthesis
 - Grain rate as sampling frequency
 - Nyquist: the highest frequency representable is $\frac{1}{2}$ the sample rate.
-
- FM rate 0,4 == 0,6



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Combining Grain pitch modulation and grain rate modulation

- Two modulators in pair
- Example: $1/2 + 1/3 = 1/6$



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Sound examples



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Conclusion

- Grain pitch modulation
- Grain rate modulation



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