

Perceptual Resonators for Interactive Worlds

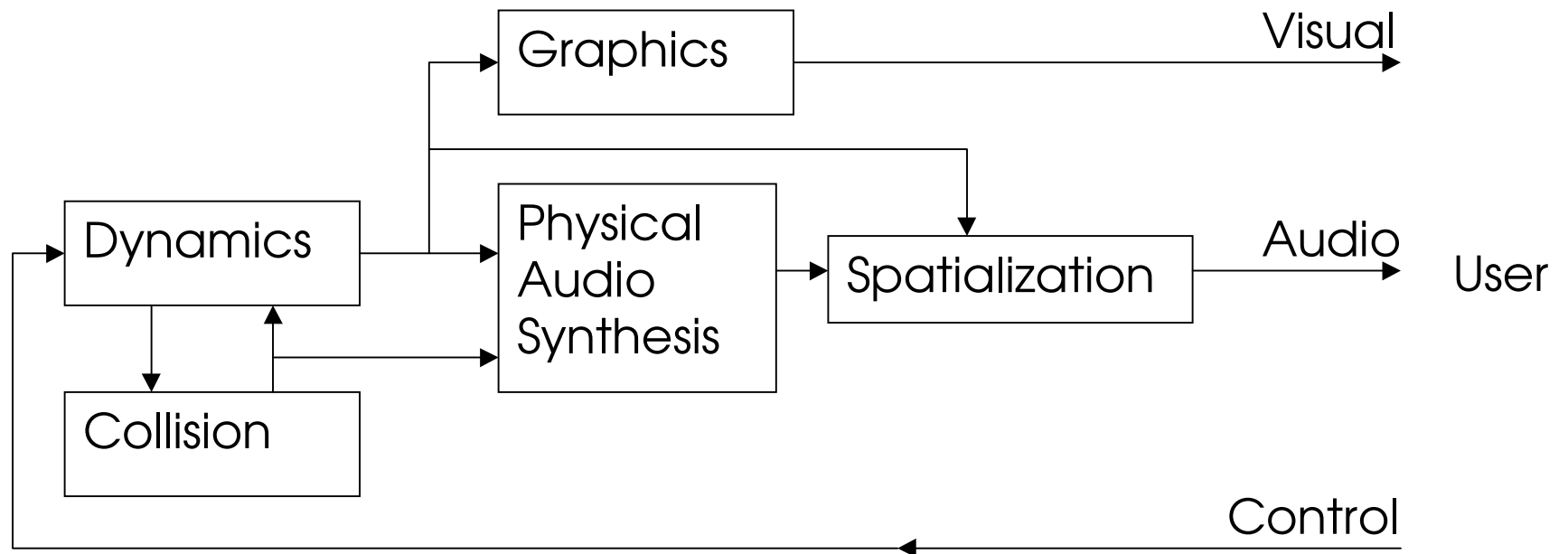
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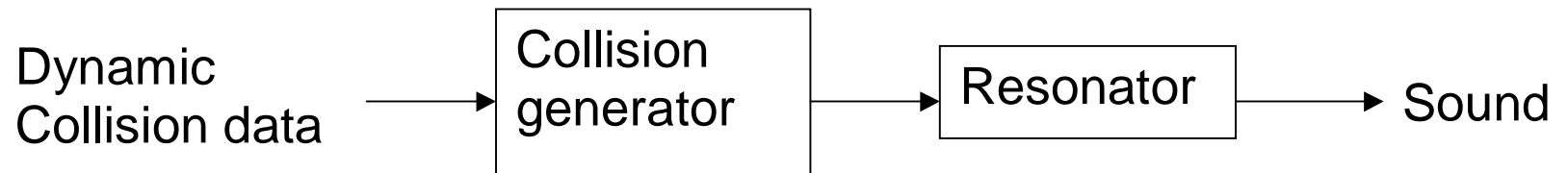
- Context - physical audio in interactive worlds.
- Modal resonators.
- Wood resonance : problematic.
- Diffuse resonance : general characteristics.
- Existing diffuse resonators : feedback-delay.
- Perceptual alternative : 'noise modes', hybrids.
- Examples.
- Conclusion.

Audio for Physical Interactive Worlds



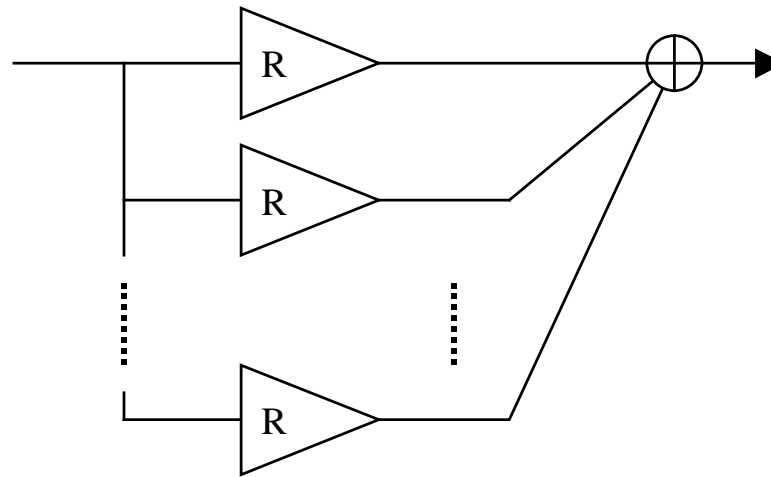
- Accurate control of audio by dynamics and collision.
- Object dynamics becomes part of audio behaviour.
- Increased realism and immersion.
- Detailed dynamics *and* collision data required.

The Collision Model



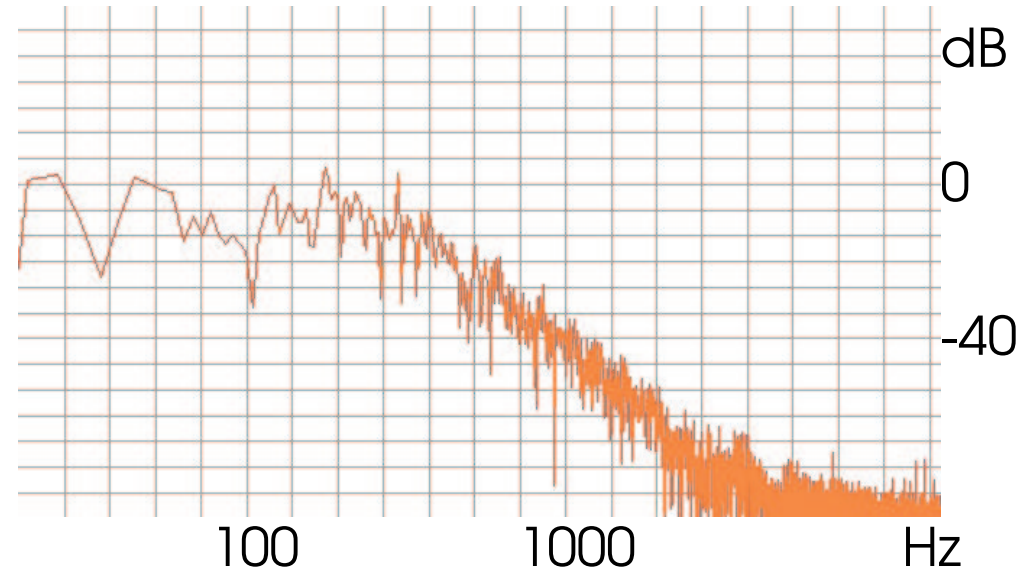
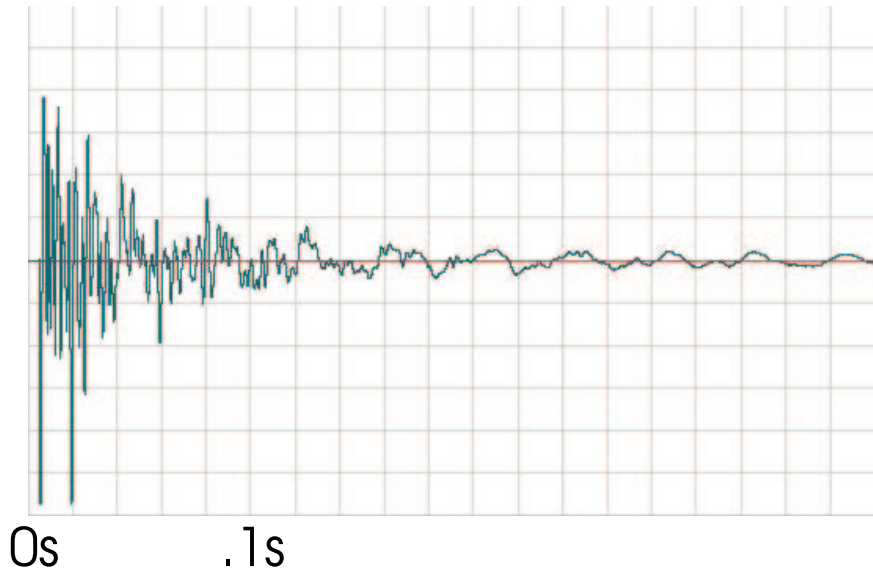
- Collision generator types - impacts and contacts.
- Covers a wide variety of natural sound.

Modal Resonator



- Calculate modes by analysing recorded-impulse.
- Efficient and realistic for small numbers of resonances: metal, glass, stone.
- Bad for wooden objects like doors, tables: Why is this?

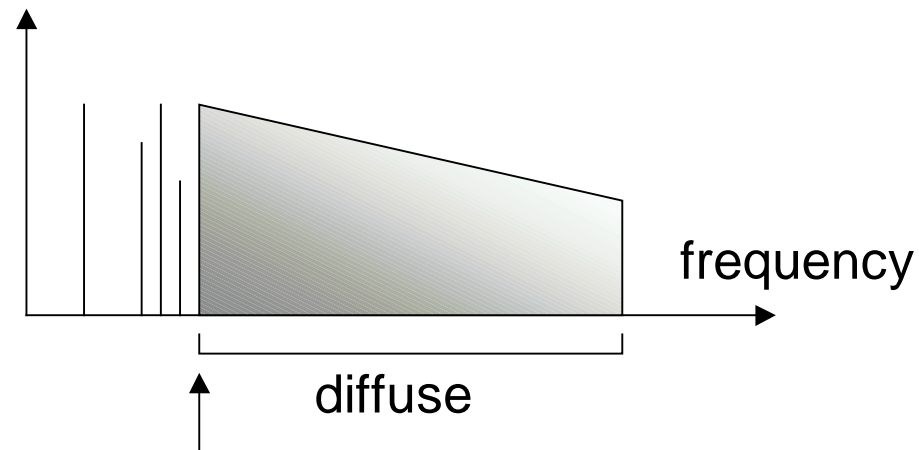
Wood resonance



[Recorded door tap](#)

[Windowed segment](#)

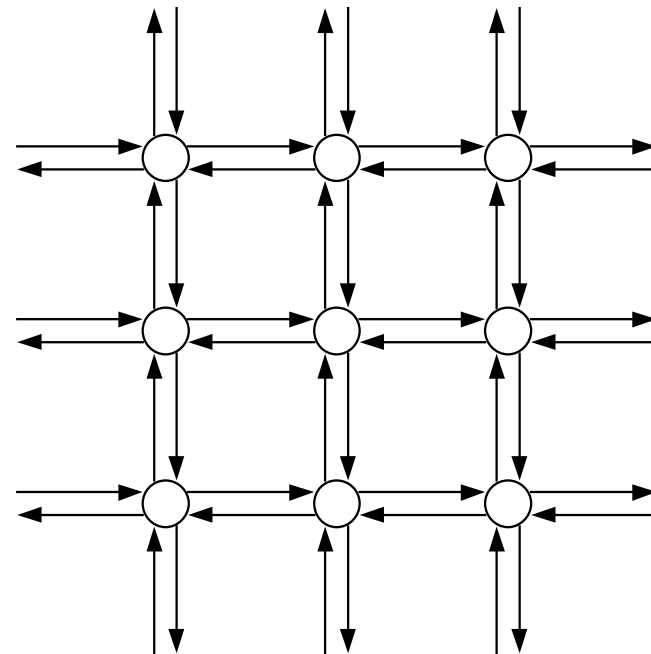
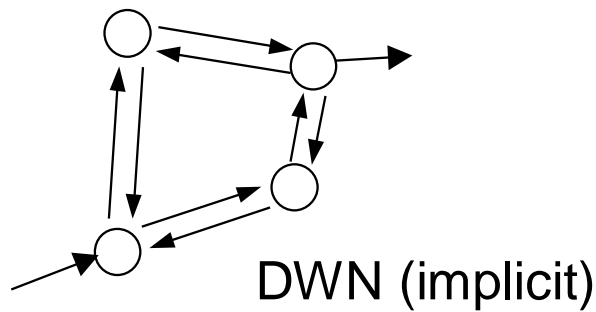
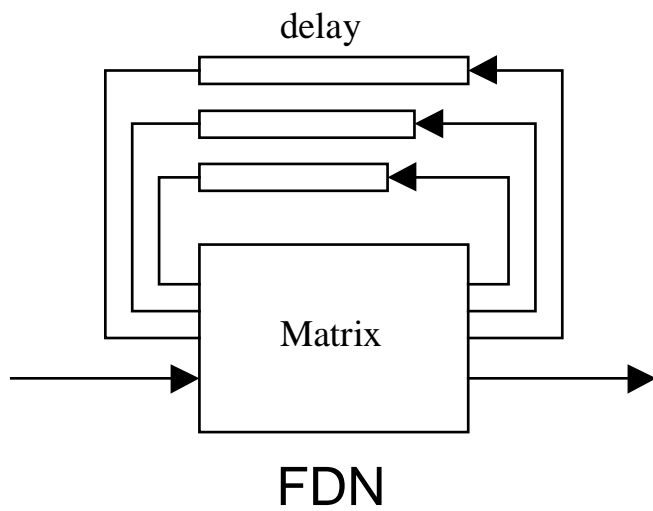
Diffuse Resonance



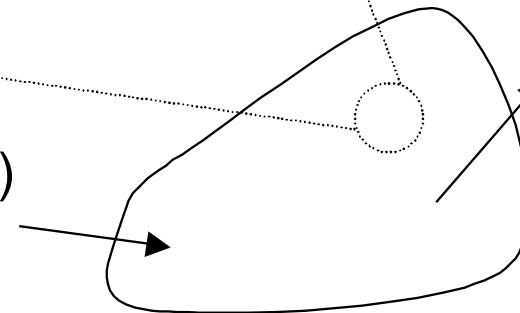
$$F_{schro} \propto \frac{c}{L}$$

- The schroeder freq is higher for harder, smaller objects.
- For metal objects the diffuse region is too high to be important, and impact widths are relatively too wide to excite high modes.
- For wooden objects diffuse region is important.

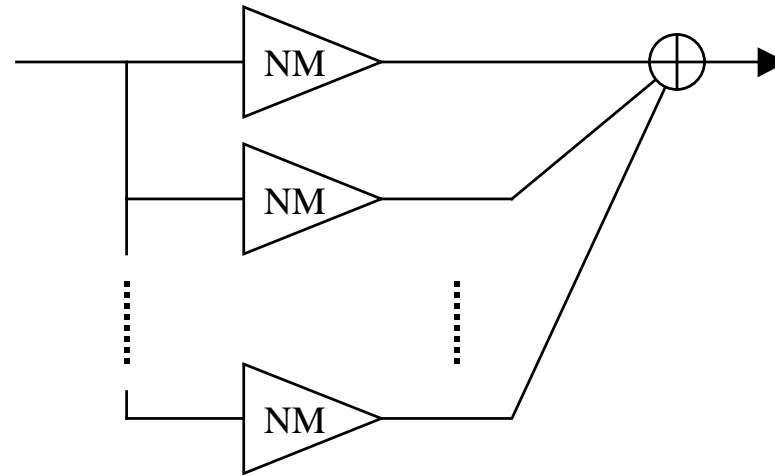
Delay-feedback Resonators



DWN (explicit)



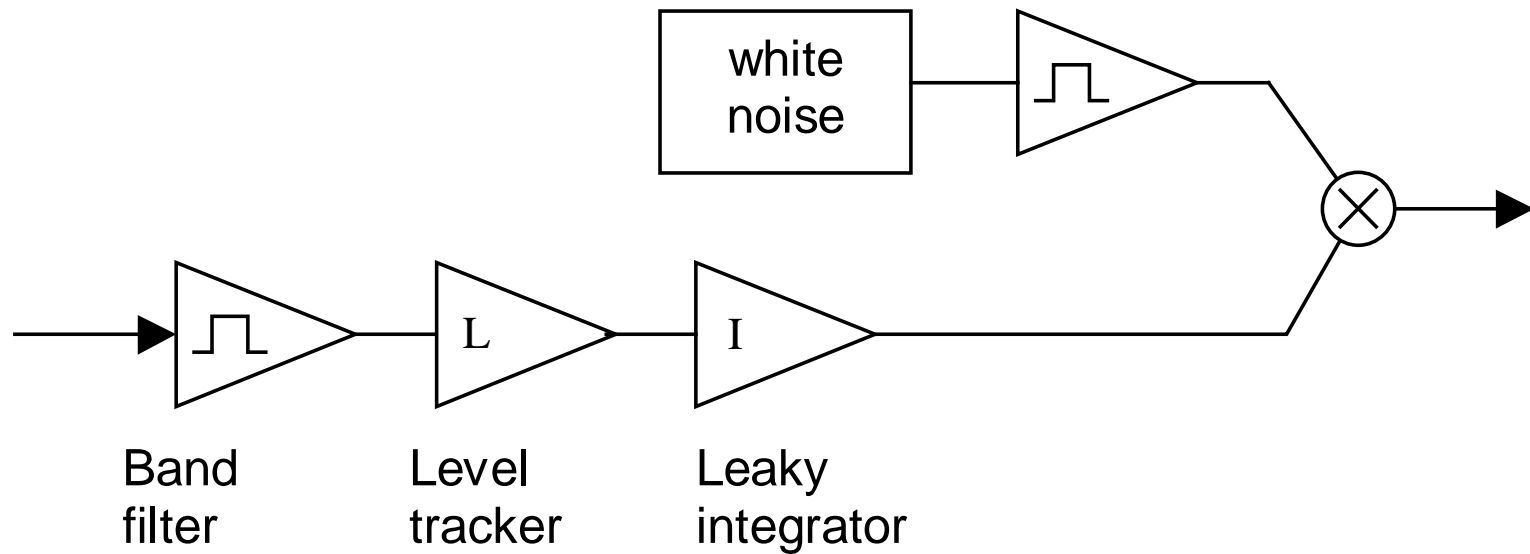
Perceptual Diffuse Resonator-Overview



NM - Noise mode

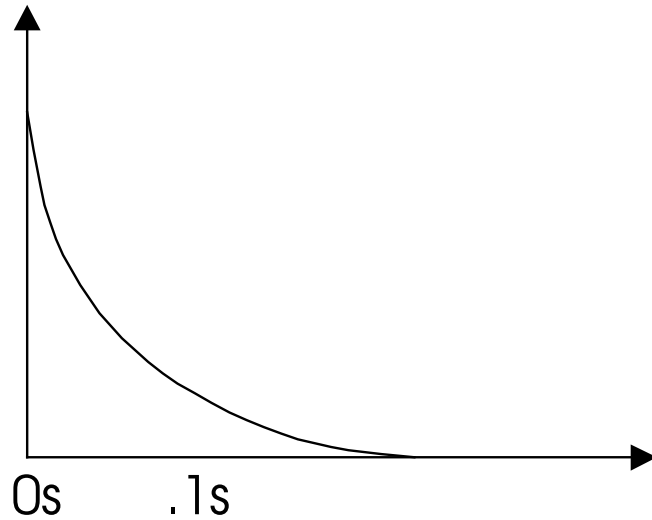
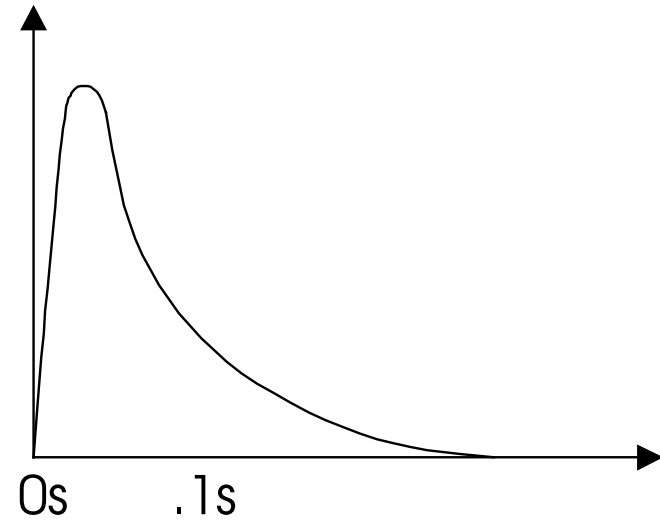
- Pseudo-linear.
- Statistically and psycho-acoustically linear.

Noise modes



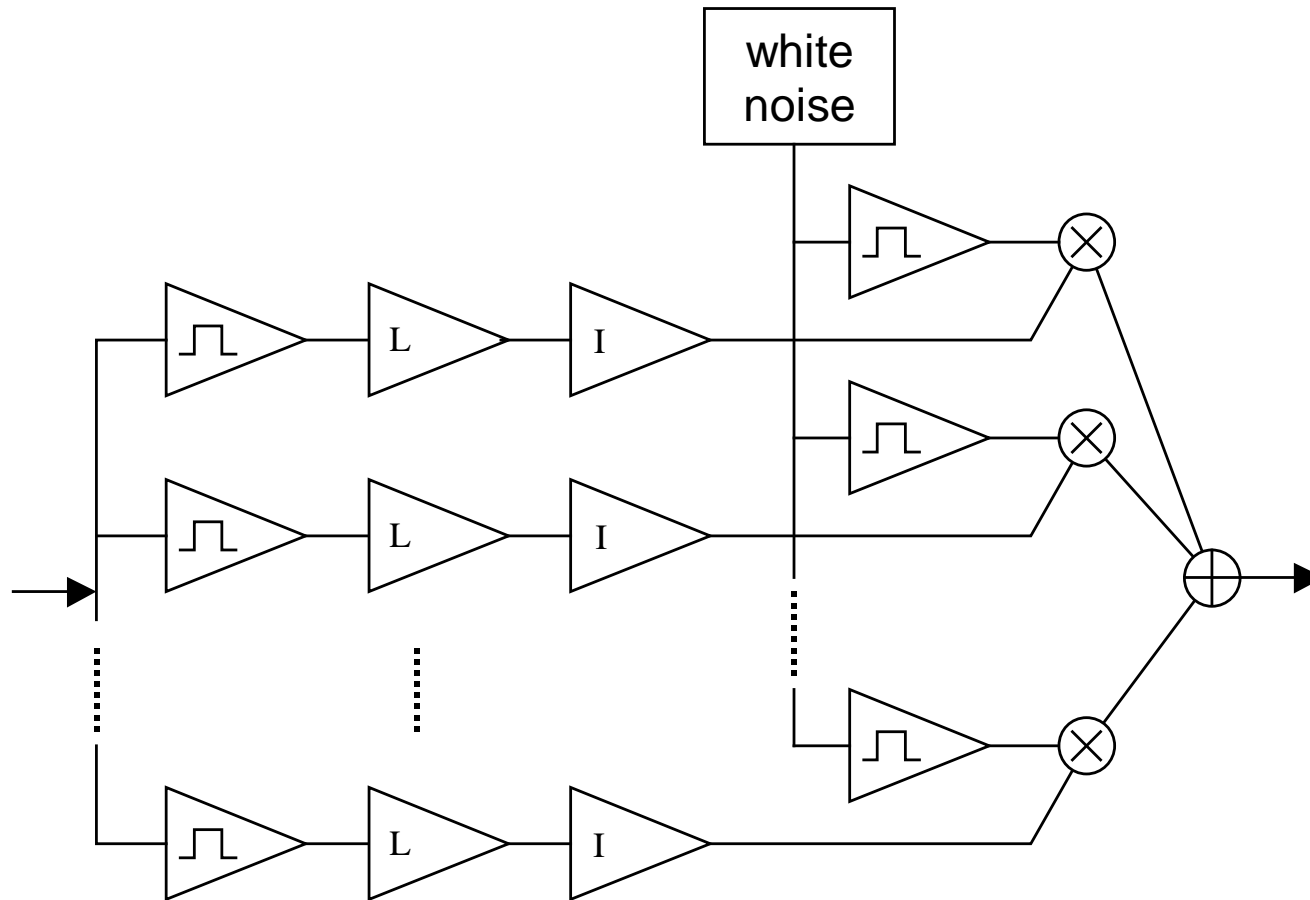
- To a first approximation convolution by a noise band is the noise band modulated by an overall gain factor.

Noise-mode Temporal-Response

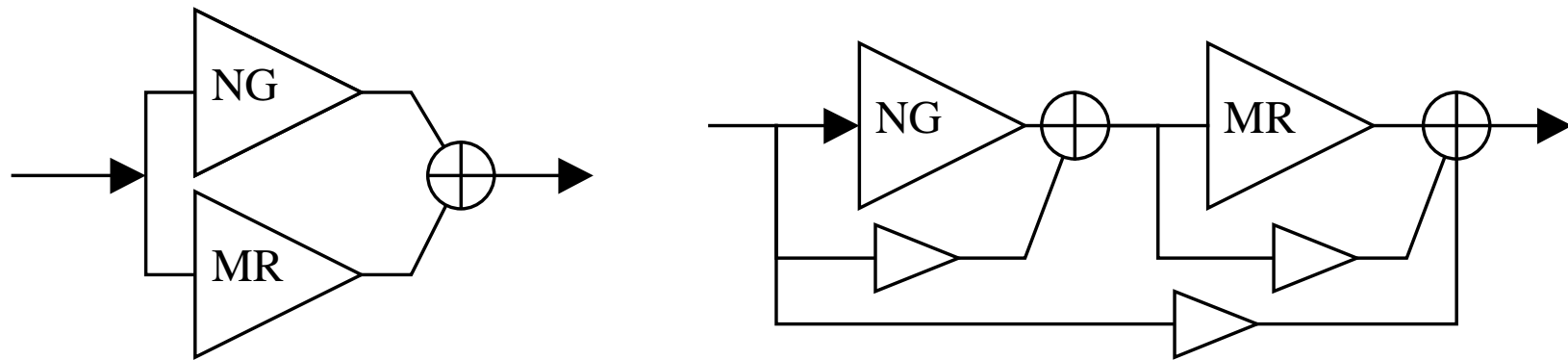
1st Order2nd Order

- 2nd order gives better fit to delayed onset of diffuse sound.
- Analogous to pre-delay in reverberation.

Perceptual Diffuse Resonator



Hybrid Resonators



MR – modal resonator
NG – noise mode generator

Examples



Low dry

Low medium

Low wet

Low wetter

High dry

High medium

High wet

High wetter

Low long

High Long

Conclusion

- Computational efficiency comparable to modal rather than delay-feedback.
- Psycho-parametric control.
- Analogies with sine+noise synthesis, eg SMS, and data driven synthesis.
- More refined analysis required.
- Application to greater variety of sounds.



