AUD401

Dynamic Audio for Digital Media

Lecture 5 ~ Audio Processing

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So far

1. Digital Sound / Sampling
2. Playing Back Files
3. Basic Oscillators
4. Sound Synthesis

5. Basic DSP (Delays, Flanger etc)

Today

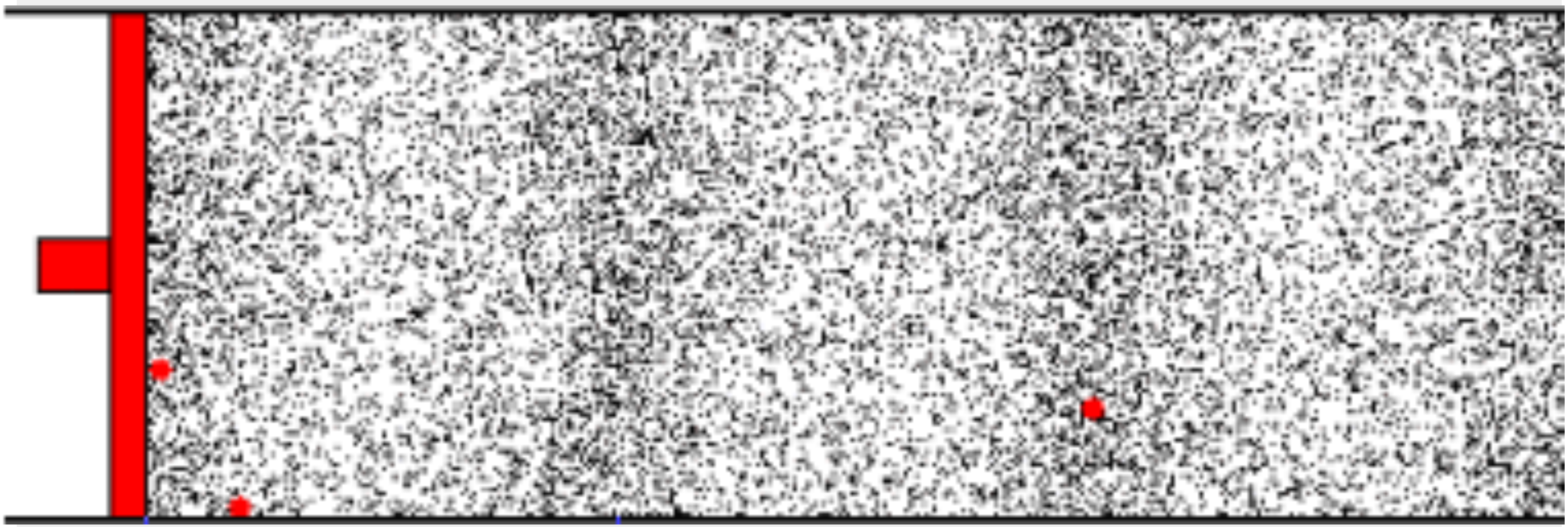
1. Pitch Shifting
2. Reverb

What’s the speed of sound?

“If you cause your ship to stop and place the head of a long tube in the water and place the outer extremity to your ear, you will hear ships at a great distance from you.”

Leonardo Da Vinci

Particles



		Gas
Arrangement of particles		Far apart Random arrangement
Movement of particles		Move quickly in all directions
Diagram		

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Arrangement of particles		Far apart Random arrangement
Movement of particles		Move quickly in all directions
Diagram		
		343.2 m/s

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Arrangement of particles		Far apart Random arrangement
Movement of particles		Move quickly in all directions
Diagram		
		343.2 m/s on 20 Celcius (?)

		Liquid	Gas
Arrangement of particles		Close together Random arrangement	Far apart Random arrangement
Movement of particles		Move around each other	Move quickly in all directions
Diagram			

343.2 m/s

on 20 Celcius (?)

		Liquid	Gas
Arrangement of particles		Close together Random arrangement	Far apart Random arrangement
Movement of particles		Move around each other	Move quickly in all directions
Diagram			
		1,484 m/s about 4.3 times as fast!	343.2 m/s on 20 Celcius (?)

	Solid	Liquid	Gas
Arrangement of particles	Close together Regular pattern	Close together Random arrangement	Far apart Random arrangement
Movement of particles	Vibrate on the spot	Move around each other	Move quickly in all directions
Diagram			

1,484 m/s

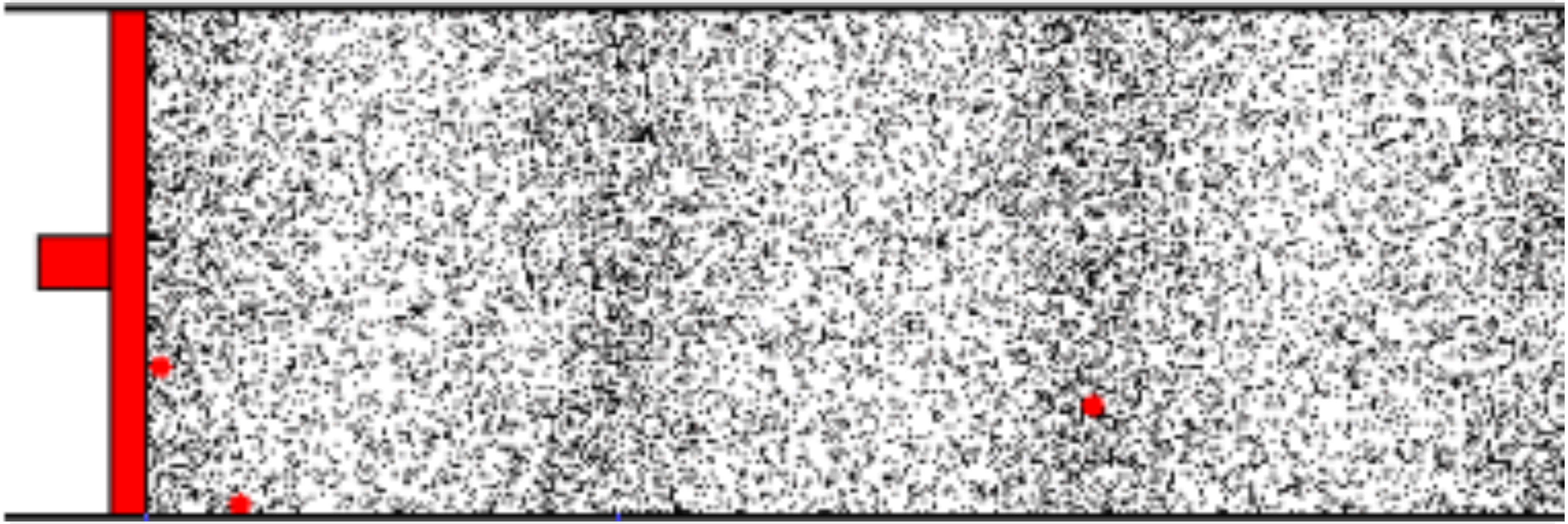
about 4.3 times as fast!

343.2 m/s

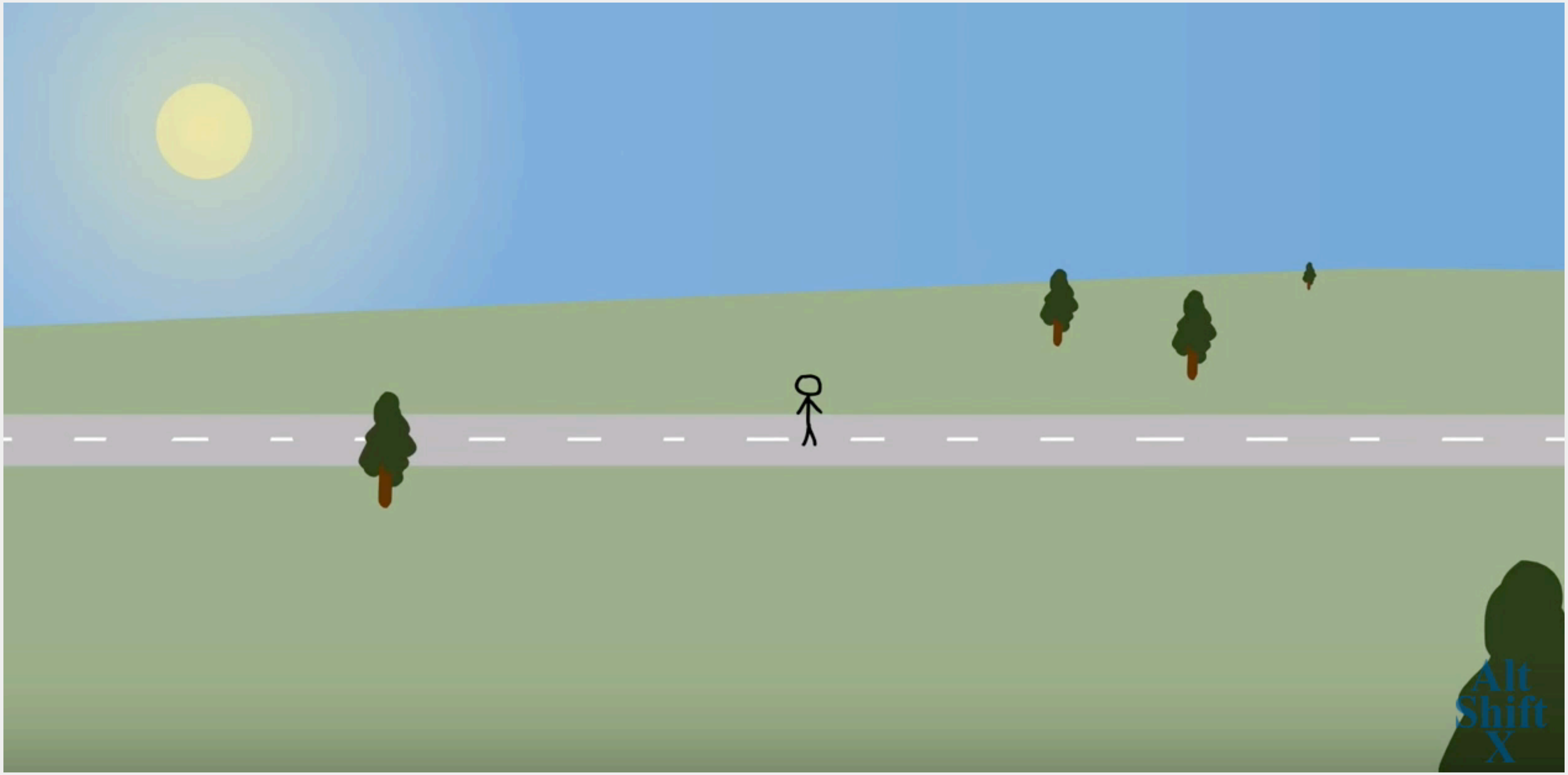
on 20 Celcius (?)

	Solid	Liquid	Gas
Arrangement of particles	Close together Regular pattern	Close together Random arrangement	Far apart Random arrangement
Movement of particles	Vibrate on the spot	Move around each other	Move quickly in all directions
Diagram			
	5,120 m/s about 15 times as fast!	1,484 m/s about 4.3 times as fast!	343.2 m/s on 20 Celcius (?)

What is Frequency?



The Doppler Effect


Alt
Shift
X

$$f = \left(\frac{c + v_\mathrm{r}}{c + v_\mathrm{s}} \right) f_0$$

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Where:

F, is the observed frequency

$$f = \left(\frac{c + v_r}{c + v_s} \right) f_0$$

Where:

F, is the observed frequency

Fo, is the emitted frequency

$$f = \left(\frac{c + v_{\mathrm{r}}}{c + v_{\mathrm{s}}}\right) f_0$$

Where:

F, is the observed frequency

Fo, is the emitted frequency

c; is the velocity of waves in the medium;

$$f = \left(\frac{c + v_{\mathrm{r}}}{c + v_{\mathrm{s}}}\right) f_0$$

Where:

F, is the observed frequency

Fo, is the emitted frequency

c; is the velocity of waves in the medium;

Vr, is the velocity of the receiver relative to the medium positive if the receiver is moving towards the source (and negative in the other direction);

$$f = \left(\frac{c + v_{\mathrm{r}}}{c + v_{\mathrm{s}}} \right) f_0$$

Where:

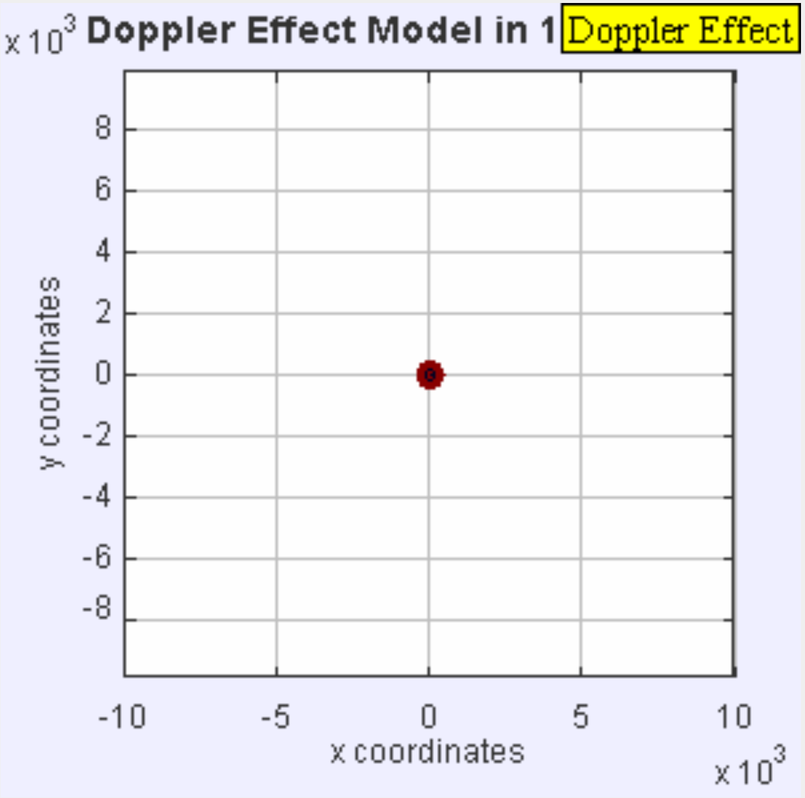
F, is the observed frequency

Fo, is the emitted frequency

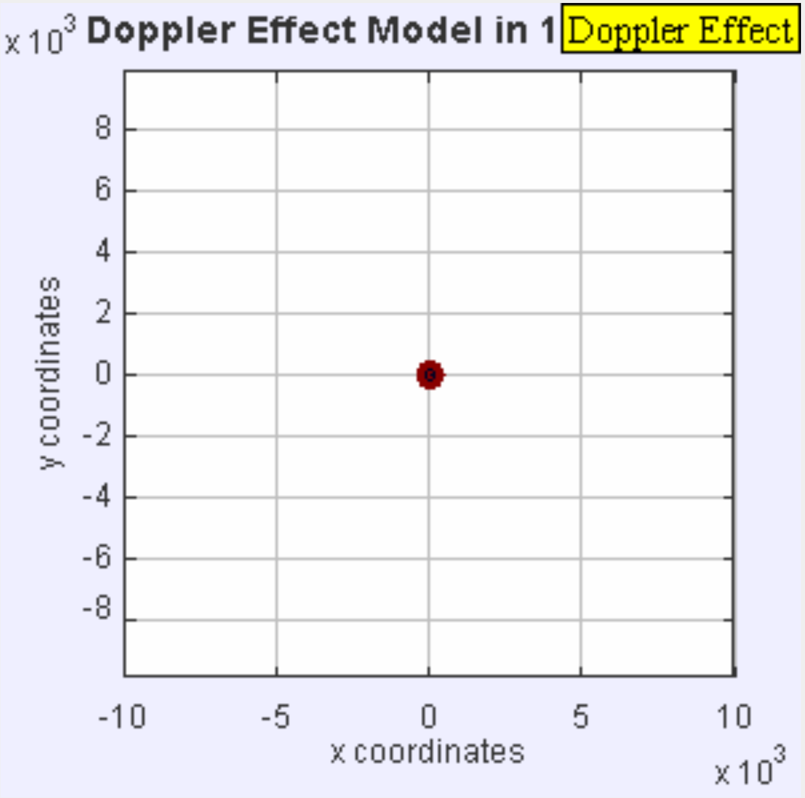
c; is the velocity of waves in the medium;

Vr, is the velocity of the receiver relative to the medium positive if the receiver is moving towards the source (and negative in the other direction);

Vs, is the velocity of the source relative to the medium; positive if the source is moving away from the receiver (and negative in the other direction).

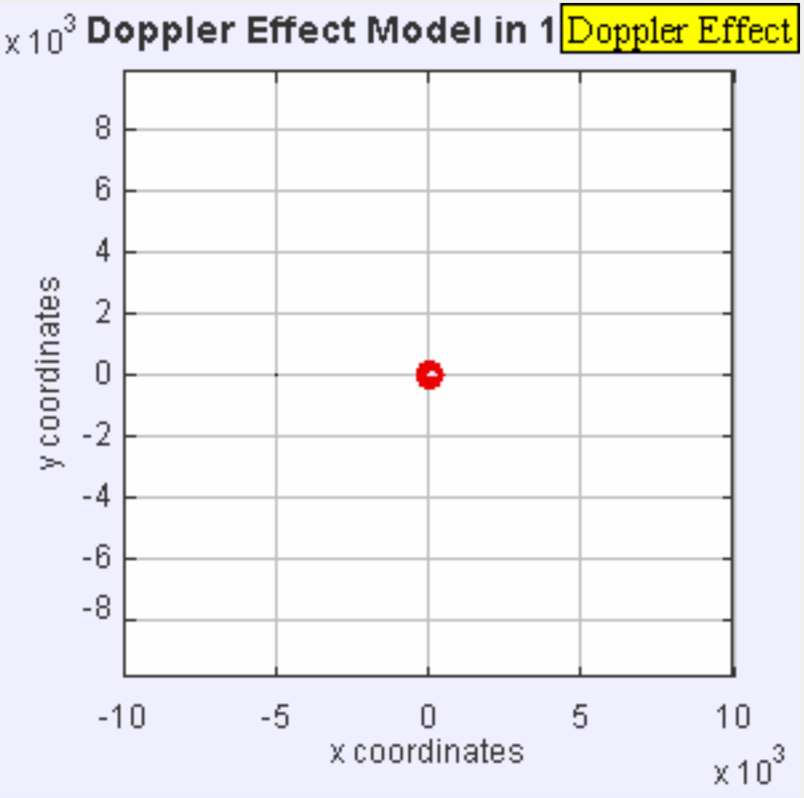


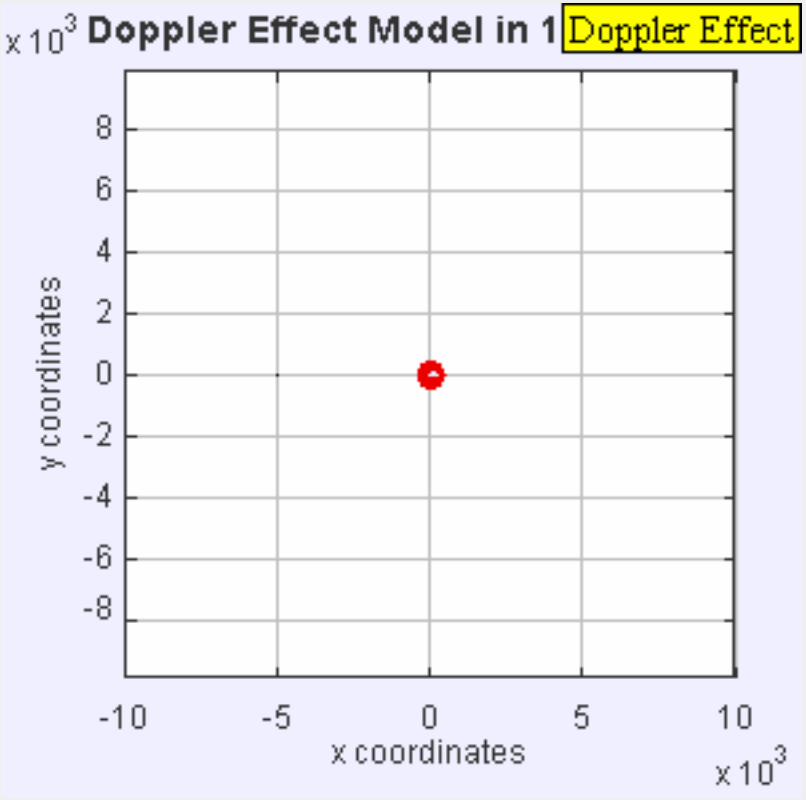
$$f = \left(\frac{c + v_r}{c + v_s} \right) f_0$$



$$f = \left(\frac{c + v_r}{c + v_s}\right) f_0$$

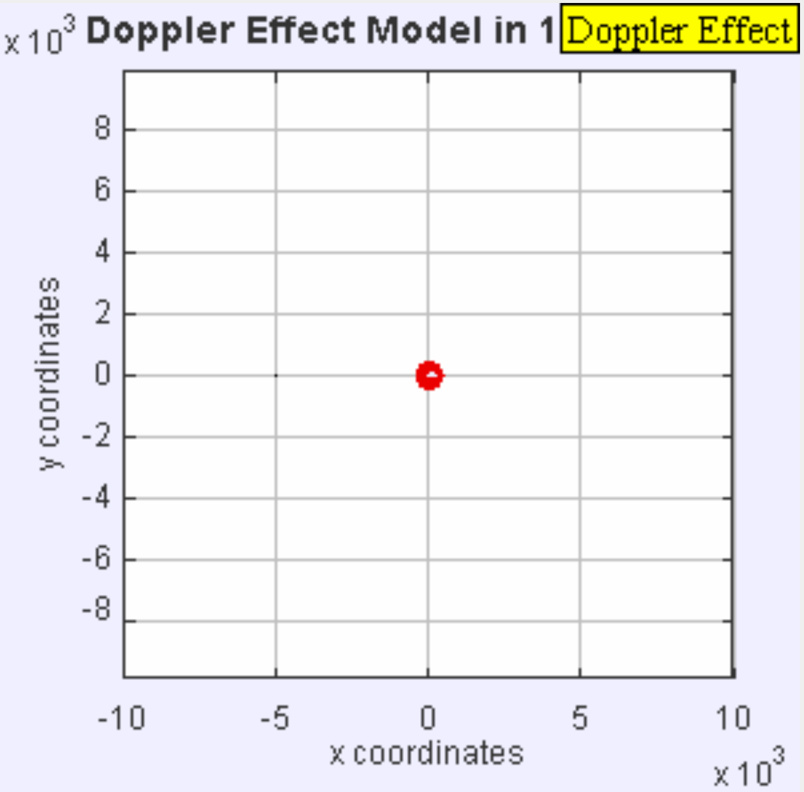
F = Fo


Doppler Effect Model in 1
Doppler Effect
x 10^3
y coordinates
x coordinates
8
6
4
2
0
-2
-4
-6
-8
-10
-5
0
5
10



$$f = \left(\frac{c + v_{\mathrm{r}}}{c + v_{\mathrm{s}}} \right) f_0$$

Let's assume that
Vs = 0.7c



$$f = \left(\frac{c + v_{\mathrm{r}}}{c + v_{\mathrm{s}}} \right) f_0$$

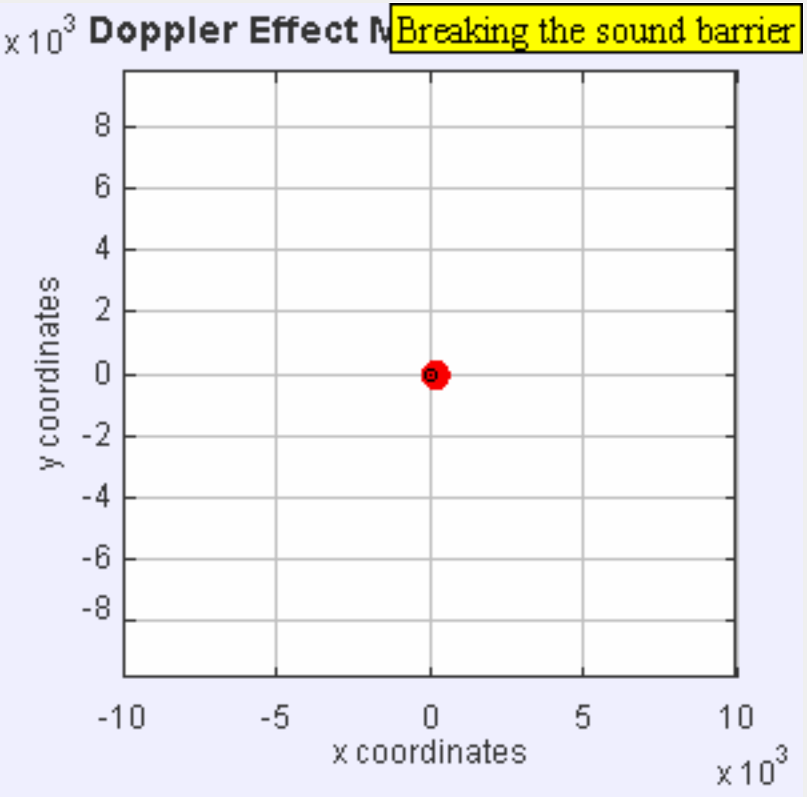
Let's assume that Vs = 0.7c

$$f = \frac{c + 0}{c - 0.7c} f_0 = 3.33\, f_0$$

while it's approaching

$$f = \frac{c - 0}{c + 0.7c} f_0 = 0.59\, f_0$$

while it's moving away



$$f = \left(\frac{c + v_r}{c + v_s} \right) f_0$$

Let's assume that
Vs = 1c
(1c = 1 Mach)

?

Therefore

Pitch Shifting occurs in the real world

We can use this process in Pd
to create a Pitch Shifter!

(by cheating nature a little bit)

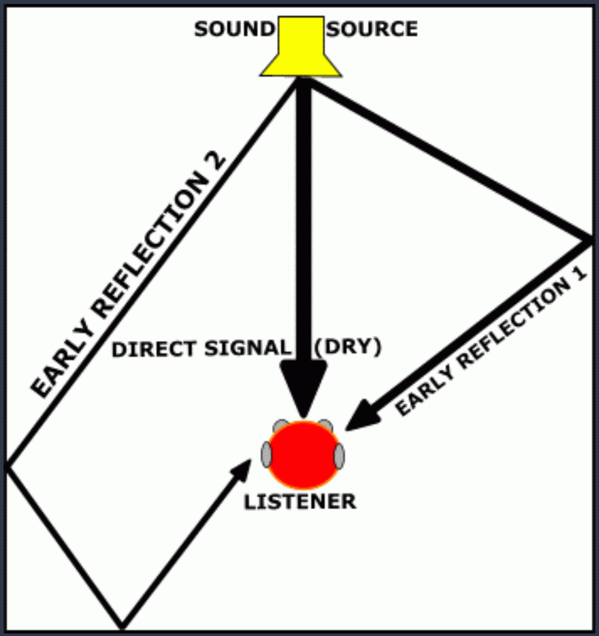
Making a Pitch Shifter using Delays

Reverberation

Reverberation

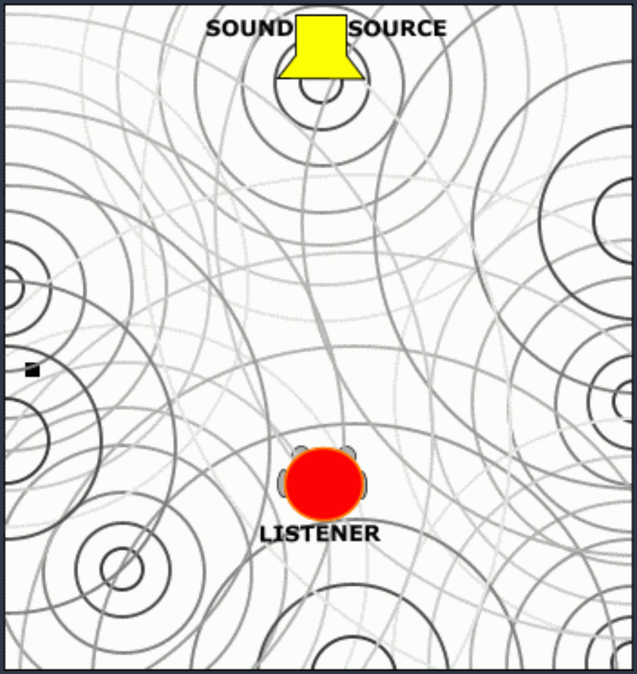
Complex patterns of delays
Due to sound bouncing off surfaces

Reverberation

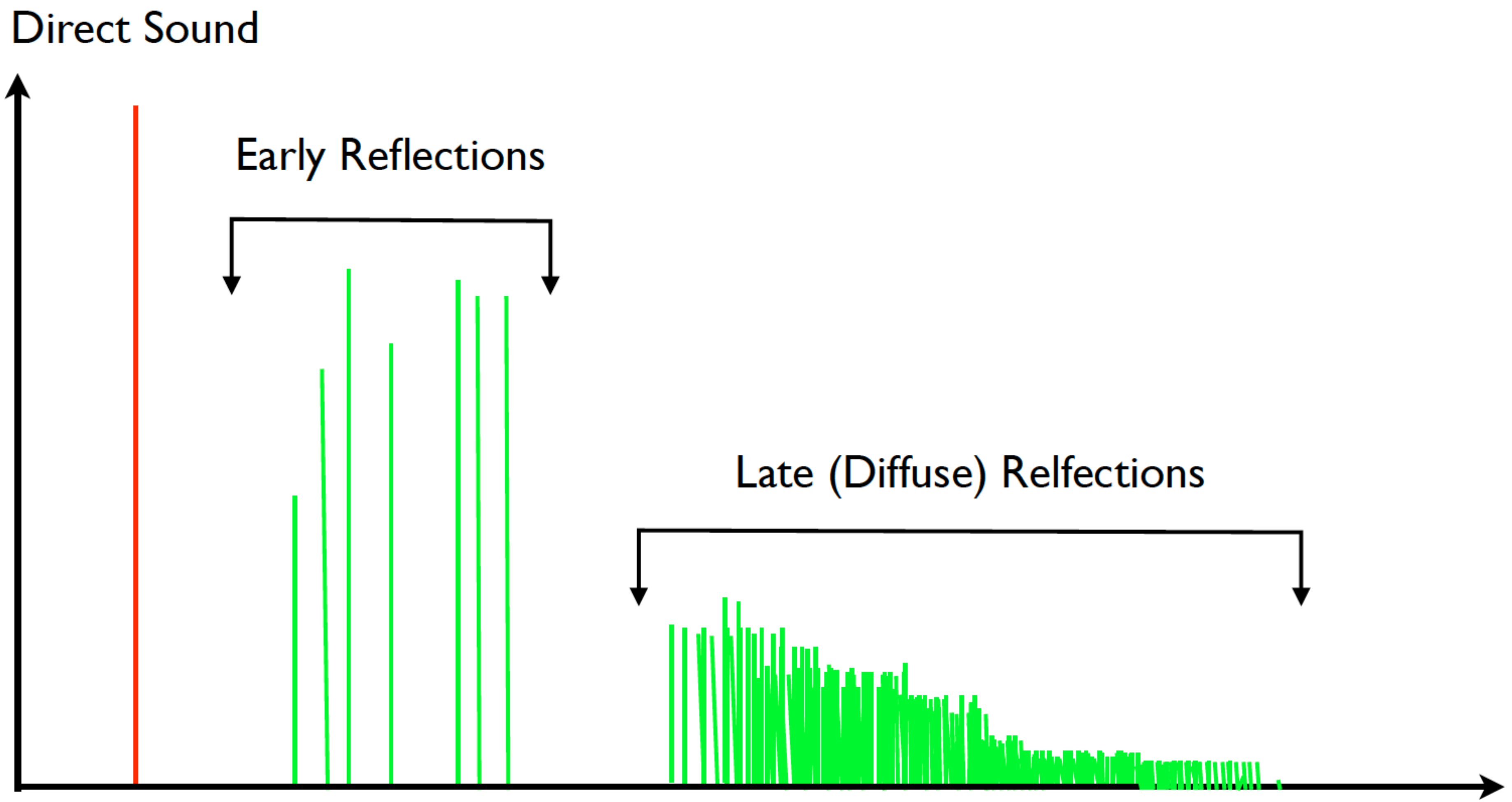


Early Reflections

Reverberation

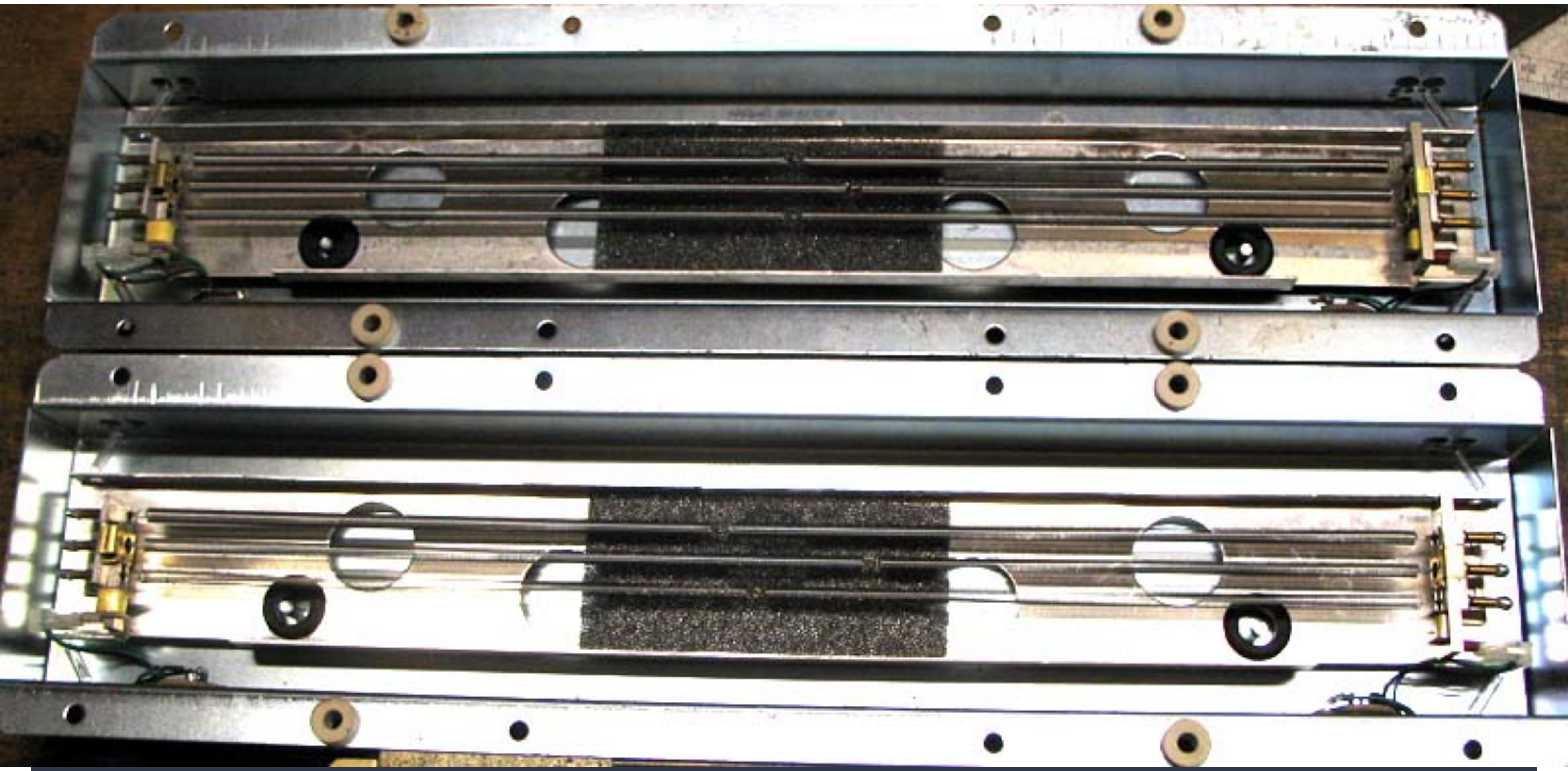


Late Reflections


Direct Sound
Early Reflections
Late (Diffuse) Relfections

Parameters

Type - are you emulating the reverb of a real space (like a room or a hall), or are you emulating a hardware reverb unit (like plate or spring reverb).



Spring

Plate

Parameters

Type - are you emulating the reverb of a real space (like a room or a hall), or are you emulating a hardware reverb unit (like plate or spring reverb).

Room size - affects the length of the reverb time, and maybe the stereo image.

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Pre-delay - the length of time it takes before you start to hear the early reflections.

Decay time - the length of time it takes for the reverb to die down.

Use the freeverb~ object in Pd

Inception The App