

# ECS614U/ECS749P: Sound Recording and Production

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`http://qmplus.qmul.ac.uk/course/view.php?id=3243`

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Semester 1, 2013–14

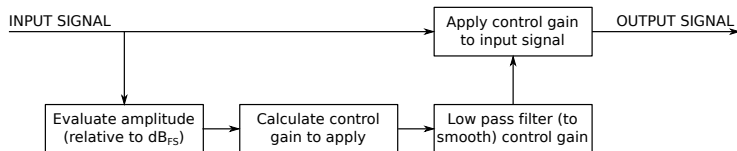
# Mixing: Dynamic Effects

# Introduction

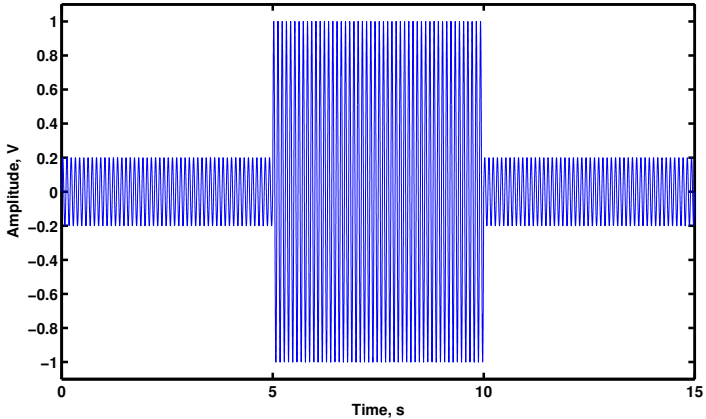
- The dynamics of an audio signal refers to the way the amplitude of the signal varies with time.
- Dynamic effects are used to alter these dynamics.
- The dynamic effect can be used to affect long term or short term dynamics.
  - **Long term** - to smooth amplitude fluctuations over the length of an audio signal.
  - **Short term** - to alter the characteristics of each transient within an audio signal.

# Dynamic effects

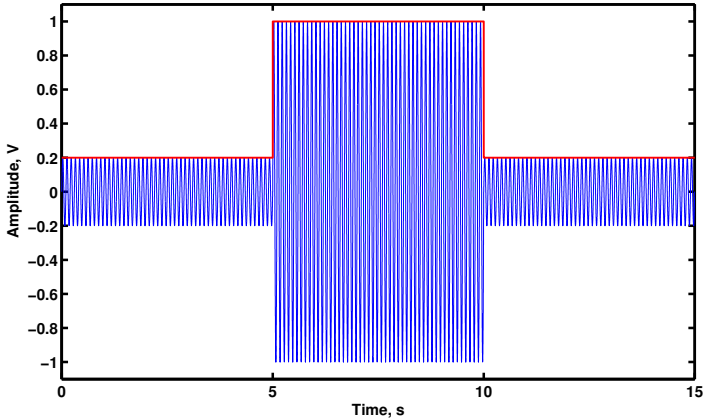
- Dynamic audio effects apply a level dependent gain to the audio signal.



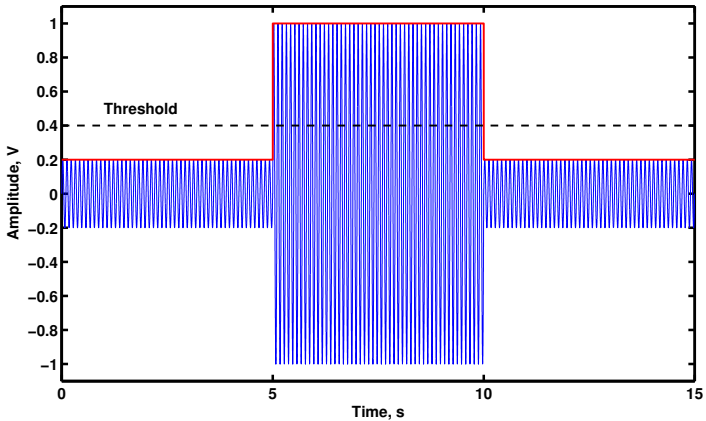
# Compression



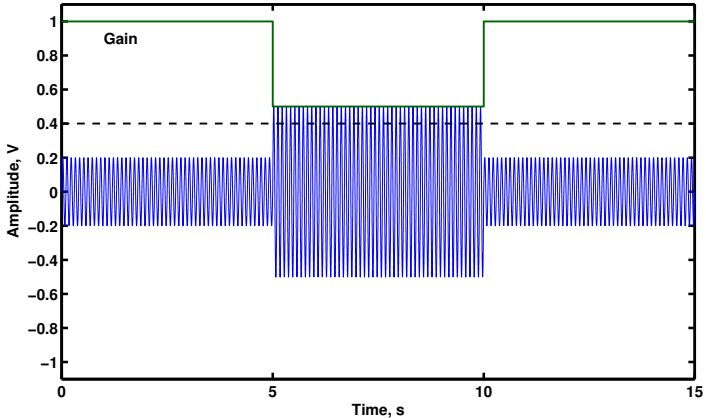
# Envelope



# Threshold

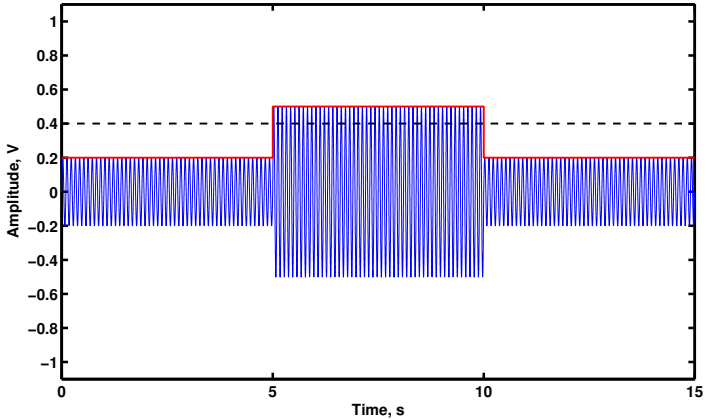


# Gain Computer





# Compressed Signal



# Dynamics

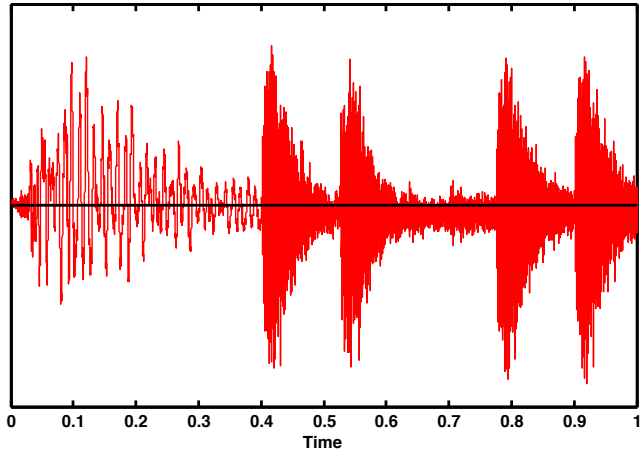
- Dynamic effects can bring about profound changes to an audio signal.
- They are very important in audio production but are also the most difficult to understand and to use well.
- Dynamic effects are adaptive digital audio effects (A-DAFx) because the processing applied to the input signal is a function of a property of the input signal.

# Envelope follower

- The amplitude is evaluated by the envelope follower.
- Most envelope followers are essentially low pass filters.
- The simplest implementation of this is an averaging filter.

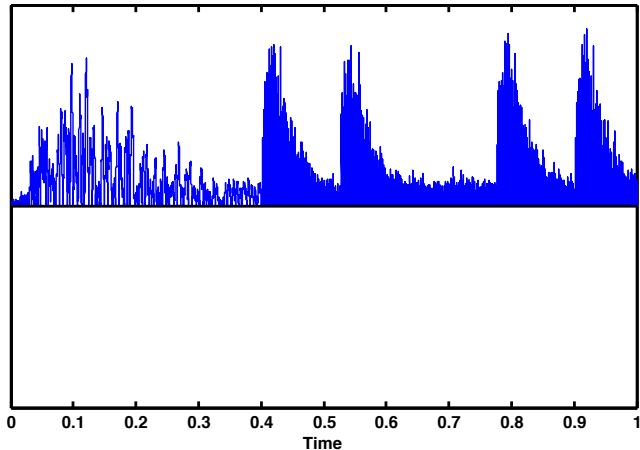
# Envelope follower

An audio signal.



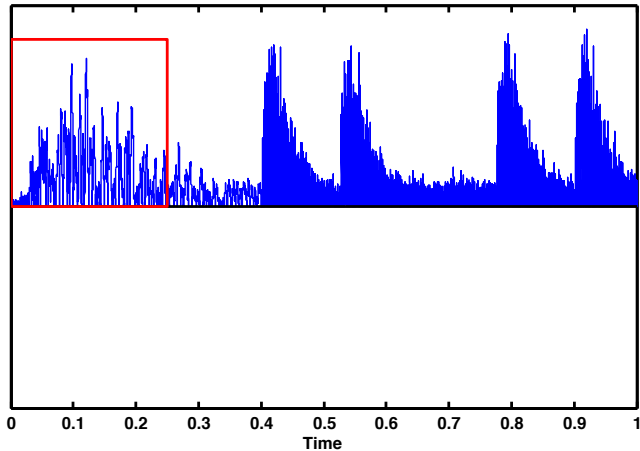
# Envelope follower

The simplest envelope is the magnitude of the audio signal.



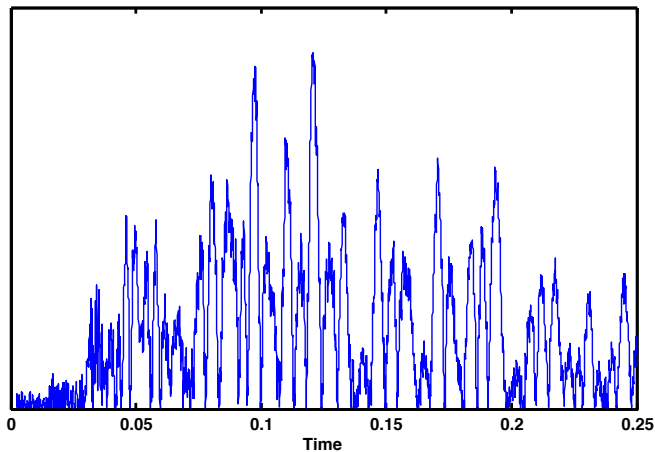
# Envelope follower

Zoom in on this section.



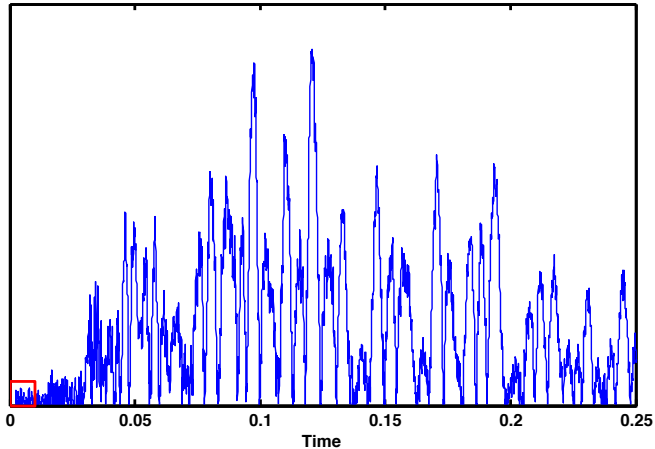
# Envelope follower

A 0.25s section of audio.



# Envelope follower

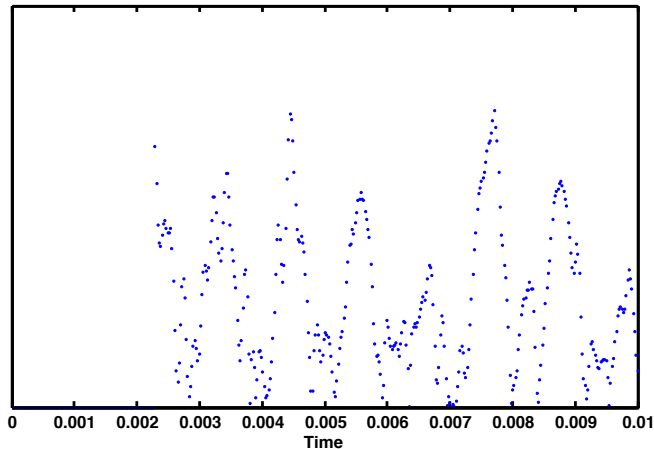
Zoom in again to see the individual samples.





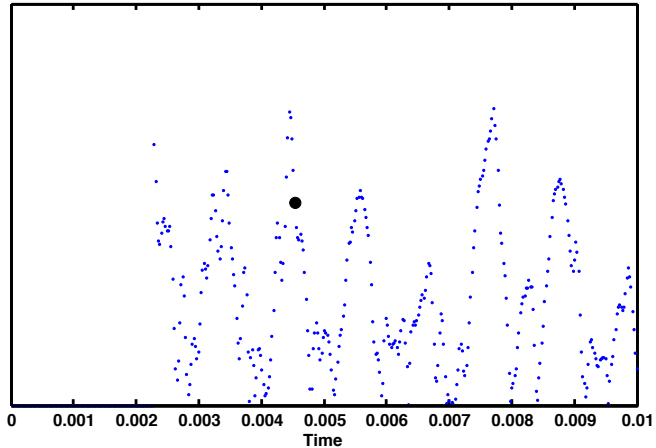
# Envelope follower

The individual samples that make up 0.01s of audio.



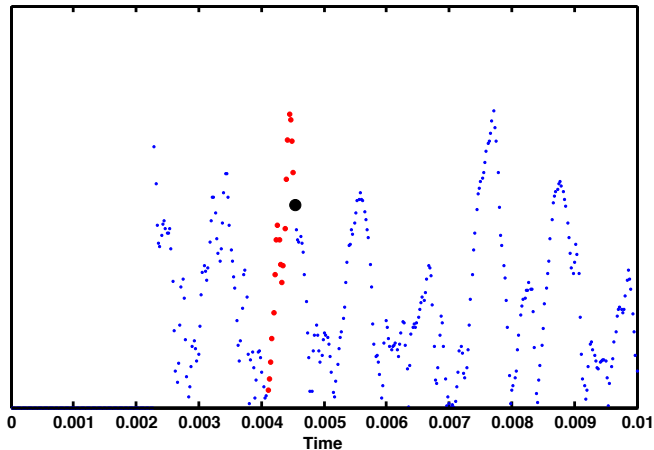
# Envelope follower

What is the amplitude of this sample?



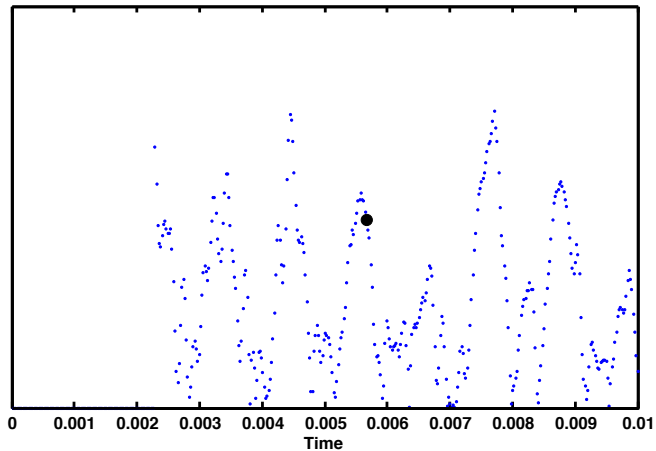
# Envelope follower

The average of this sample, and a number of previous samples.



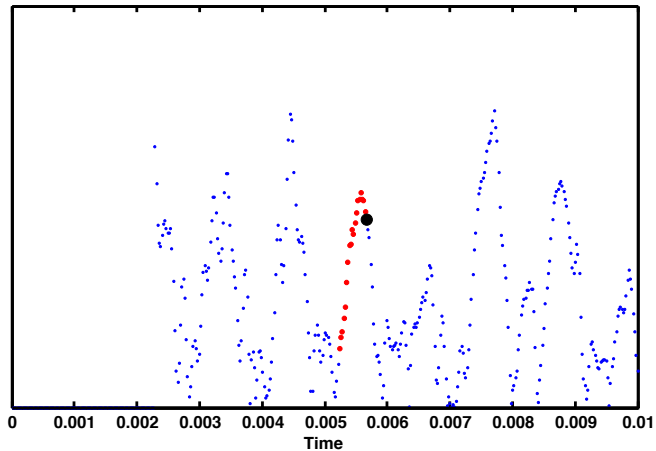
# Envelope follower

And this one?



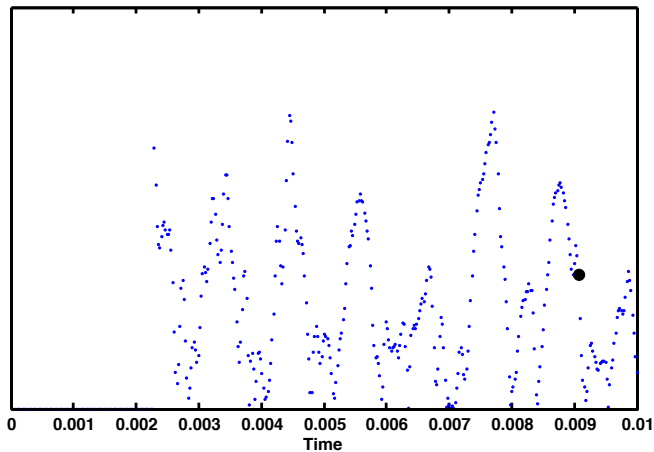
# Envelope follower

Same again.



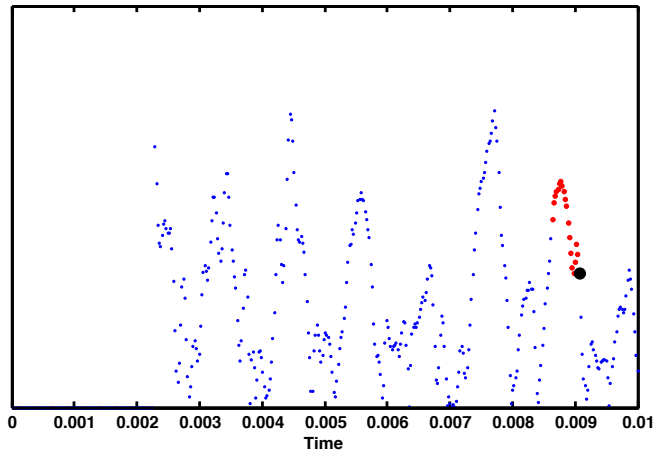
# Envelope follower

And this?



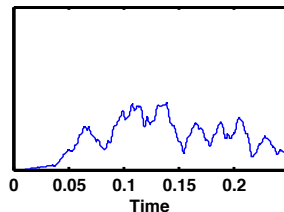
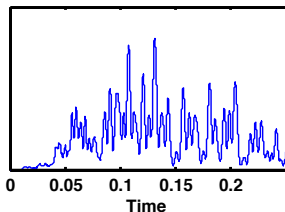
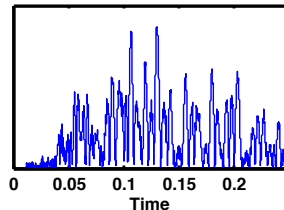
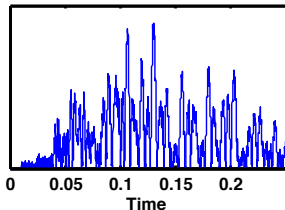
# Envelope follower

Same again.



# Envelope follower

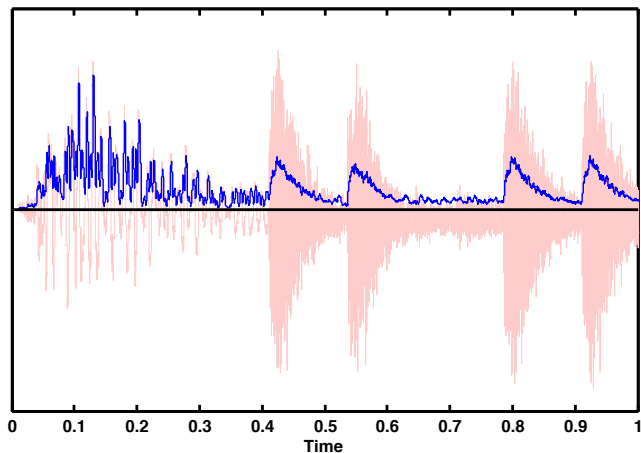
What happens when we change the number of samples used in the average?





# Envelope follower

The final envelope for the 1s signal using average of 100 samples.



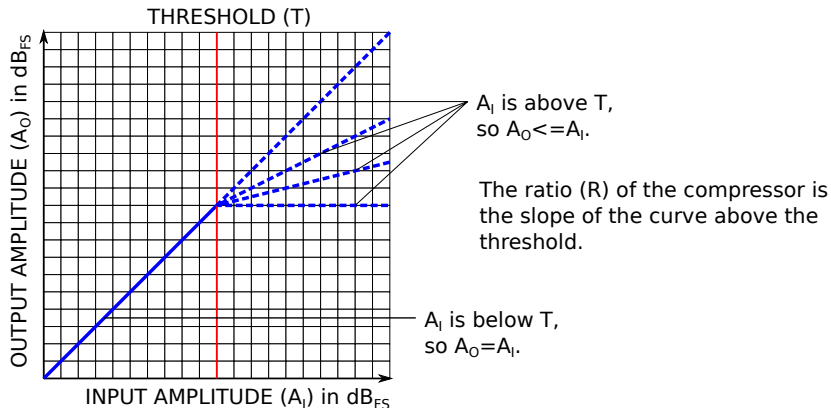
# Envelope follower

- The envelope follower outputs the signal amplitude.
- The output from the envelope follower is **NOT** an audio signal. It is data.
- The amplitude data is input to the gain computer.

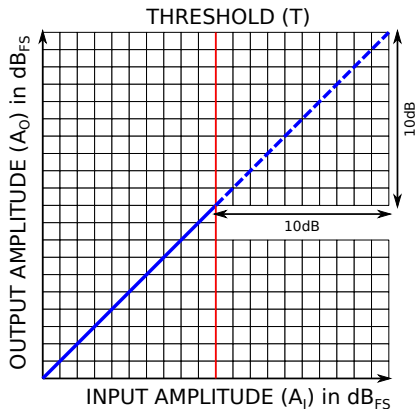
# Gain computer

- The gain computer takes in the amplitude data and calculates the gain that needs to be applied to each sample.
- **Compressor** - decrease the amplitude of samples that are above a certain threshold (make the loud bits quieter and decrease the dynamic range).
- **Expander** - decrease the amplitude of samples that are below a certain threshold (make the quiet bits quieter and increase the dynamic range).

# Compressor gain function



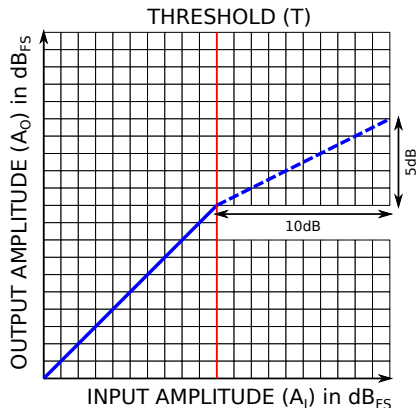
# Compressor gain function



The ratio ( $R$ ) of the compressor is the slope of the curve above the threshold.

$$R = 10/10 = 1$$

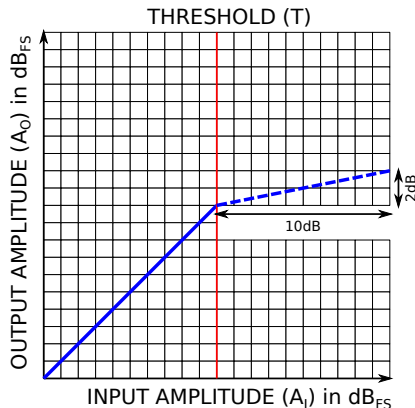
# Compressor gain function



The ratio ( $R$ ) of the compressor is the slope of the curve above the threshold.

$$R = 10/5 = 2$$

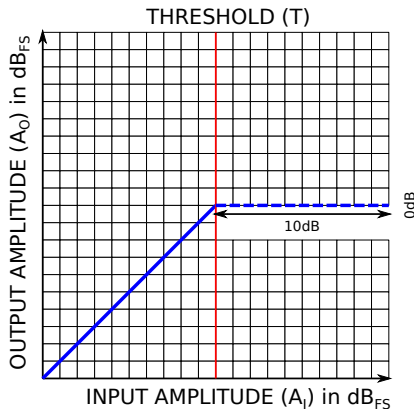
# Compressor gain function



The ratio ( $R$ ) of the compressor is the slope of the curve above the threshold.

$$R = 10/2 = 5$$

# Compressor gain function

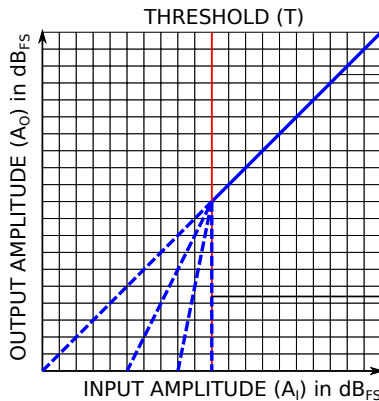


The ratio ( $R$ ) of the compressor is the slope of the curve above the threshold.

$$R = 10/0 = \text{infinity}$$



# Expander gain function



$A_i$  is above  $T$ ,  
so  $A_o = A_i$ .

The ratio ( $R$ ) of the expander is  
the slope of the curve below the  
threshold.

$A_i$  is below  $T$ ,  
so  $A_o < A_i$ .

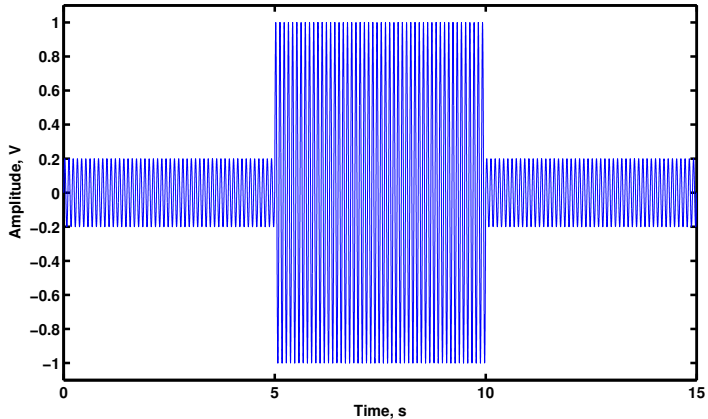
# Make up gain

- When we compress a signal we invariably reduce the peak amplitude.
- Compressors have a **make up gain** control which adds gain to the signal after it has been compressed. This enables the any loss of gain to be compensated for.
- Beware, most compressors have a positive default setting (+**4dB** in Logic compressor) .

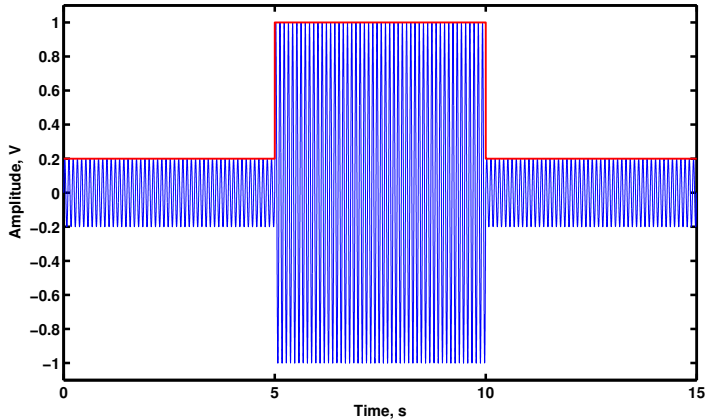
# Dynamic effect time constants

- The time constants determine how quickly the compression or expansion gain function takes affect.
- **Attack** - how quickly the gain function is applied.
- **Release** - how quickly the gain function is removed.

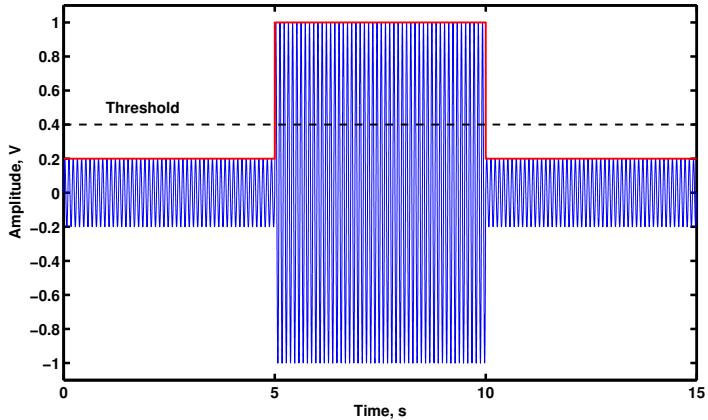
# Compression



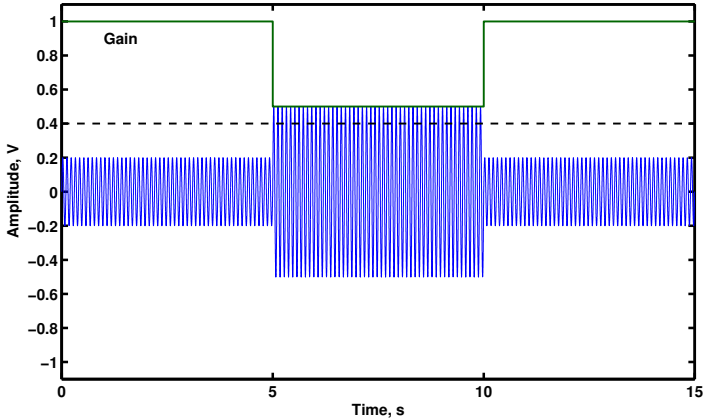
# Compression



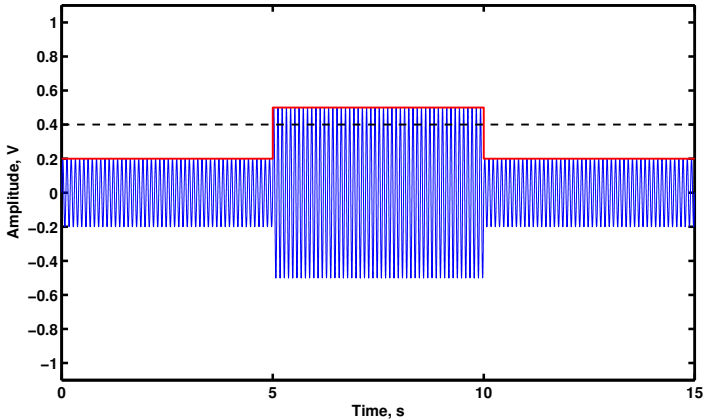
# Compression



# Compression

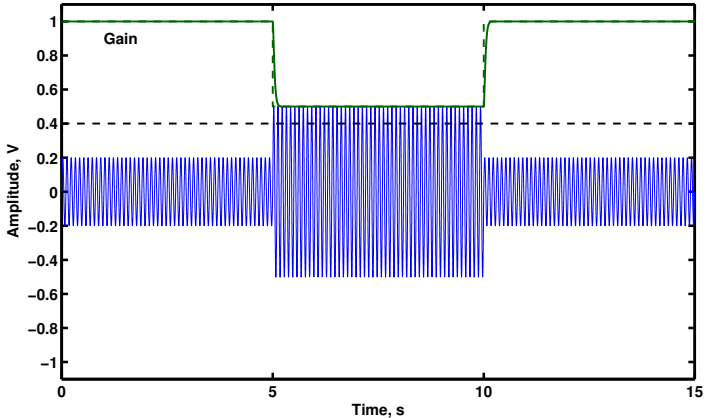


# Compression

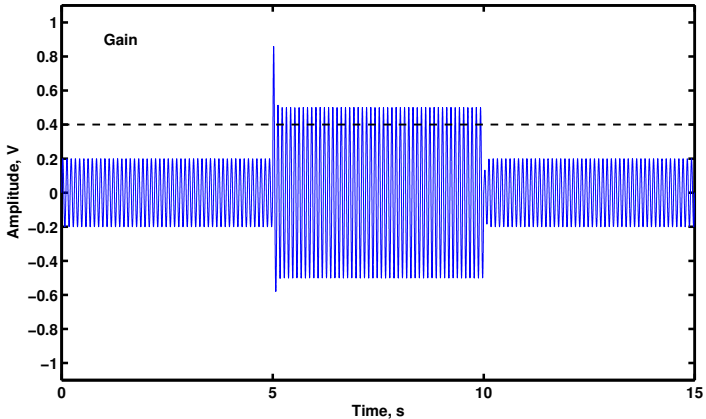




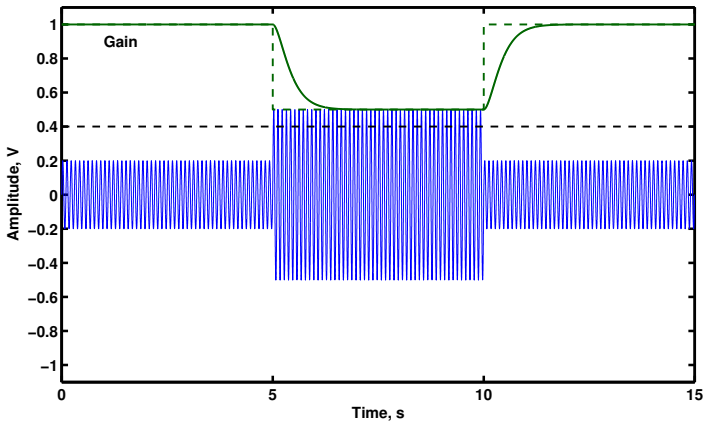
# Dynamic Effect Time Constants



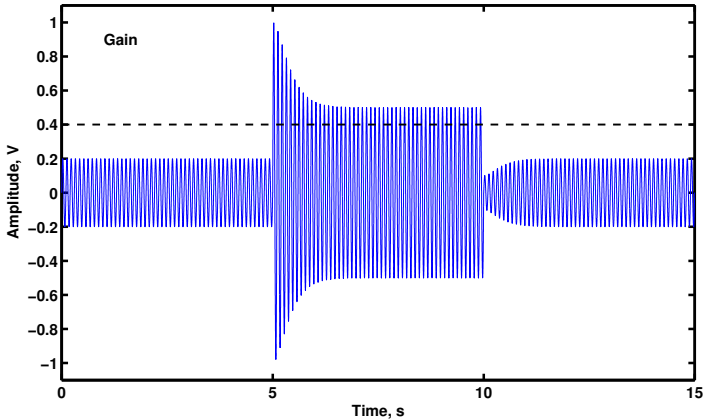
# Dynamic Effect Time Constants



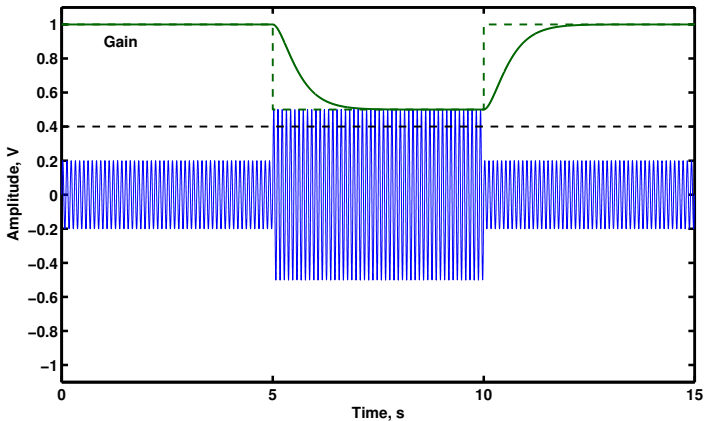
# Dynamic Effect Time Constants



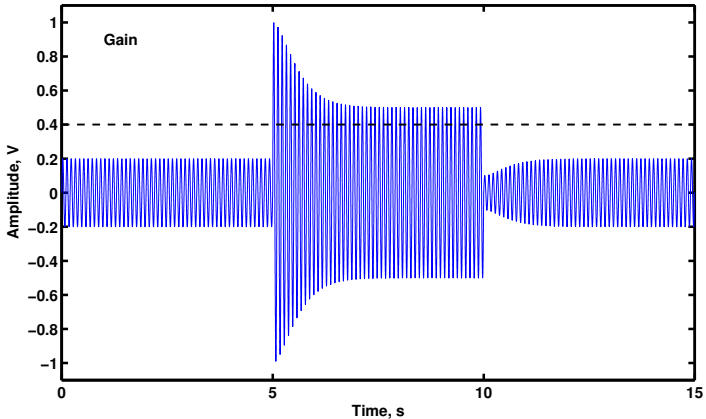
# Dynamic Effect Time Constants



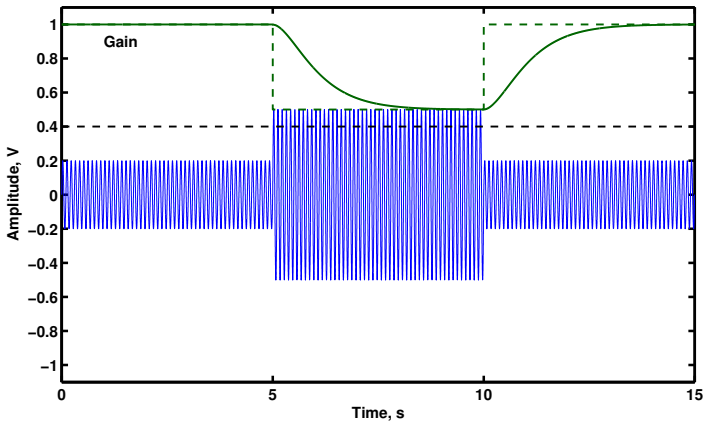
# Dynamic Effect Time Constants



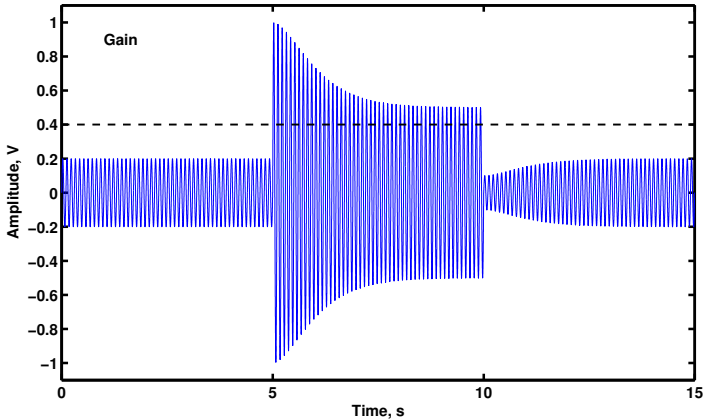
# Dynamic Effect Time Constants



# Dynamic Effect Time Constants



# Dynamic Effect Time Constants





# Limiters and noise gates

- A limiter is a special case implementation of a compressor. What is special about it?
- A noise gate is a special case implementation of an expander. What is special about it?

# Real dynamic effect implementations

- Real implementations, in particular analogue or analogue emulations do not strictly follow the flow chart shown earlier.
- Analogue implementations have more complex characteristics.
- Current trend is to use analogue circuit modelling to emulate analogue effects.

# The position in the production chain

- Dynamic effects are nonlinear.
- Dynamic effects are auto-adaptive, i.e. the processing that is applied depends on properties of the input signal.
- The resultant sound will depend on the position of the dynamic effect within the effects chain.
- Generally (but not always!) use a dynamic effects first, especially use compressor before equalizer.