**[11:00-11:35] Continuation of Lecture 1: Sampling and sound in MATLAB**

A paper with writing on it

AI-generated content may be incorrect.

To reconstruct a frequency , a signal must be sampled at a rate strictly greater than .

It’s common to sample much higher than . Audio is often sampled at 48,000 Hz or higher, even though the maximum audible frequency is between 15,000 Hz and 17,000 Hz for most adults.

A close-up of a paper

AI-generated content may be incorrect.

MATLAB’s sound(x) command will play an audio signal represented by an array x using the default sample rate of 8192 Hz. A different sampling rate fs can be specified using sound(x,fs), in which case MATLAB will automatically [resample](https://en.wikipedia.org/wiki/Sample-rate_conversion) the sound to a rate that is compatible with the computer’s sound system.

The soundsc command will scale the range of the signal to [-1, 1] prior to playing it. This increases the volume of small amplitude signals and prevents clipping when playing a signal whose amplitude exceeds the range [-1,1].

**[11:35 – 12:05] Systems**

Systems operate on one or more input signals to produce one or more output signals.

Examples:

Averaging a continuoussignal with a one-second delayed version of itself:

Discrete time low-pass averaging filter:

Squaring block:

The squaring block is nonlinear and changes the frequency or frequencies of the input signal . The output of the squaring block contains:

* Double the frequency (or frequencies) of
* A DC offset (zero Hertz)

**[11:55-12:05] Lecture 2: Periodic signals**

A signal is periodic with period if for any integer .

A periodic signal can have multiple periods. The smallest positive period is the fundamental period.

**Time shift and phase shift**

A common system involves shifting a signal in time by seconds. If is positive, this system is also called a delay.

For sinusoids, a time shift causes a phase shift:

Phase shifts are commonly used in wireless communications, sonar, and radar systems to separate signals spatially.