Signals and Systems (ELL205)

By Dr. Abhishek Dixit

Dept. of Electrical Engineering

IIT Delhi

Use cases

- Fundamentals
  - Digital signal processing (MP3, JPEG, MP4)
  - Communication systems
  - Machine learning
  - Neural networks
  - Optical signal processing
  - Biomedical signal processing
  - Physics
  - Mathematics
  - Computer science (data mining)
  - Mechanical and civil engineering

No innovation and engineering happens without knowledge of Signals and Systems

Work contribution

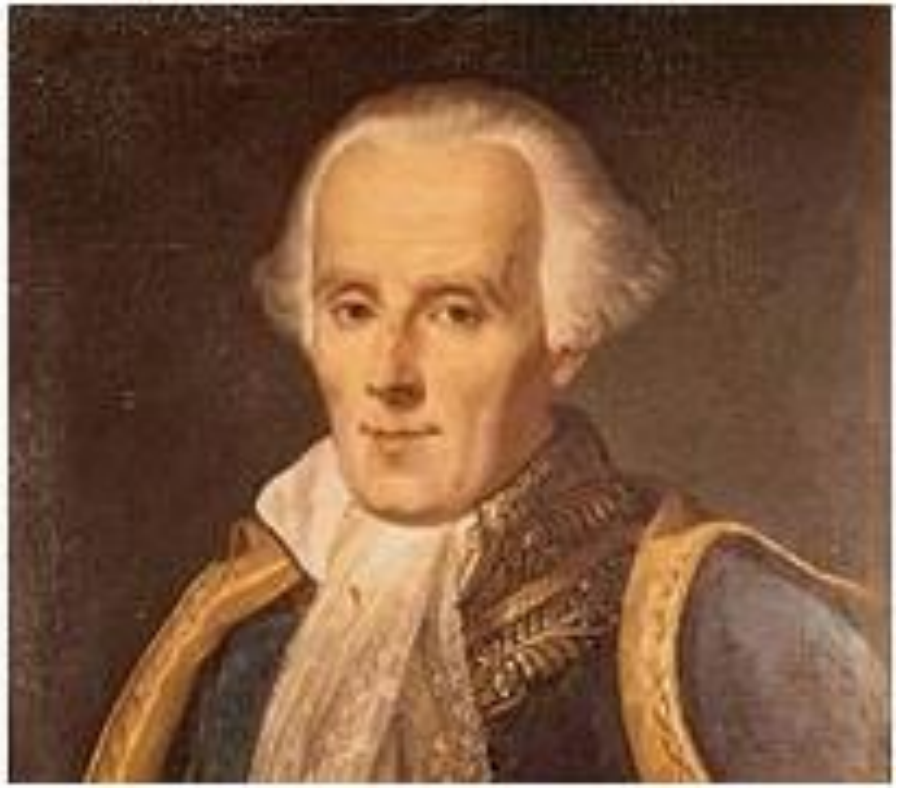
- **Euler**

Work contribution

- Euler
- **Fourier**

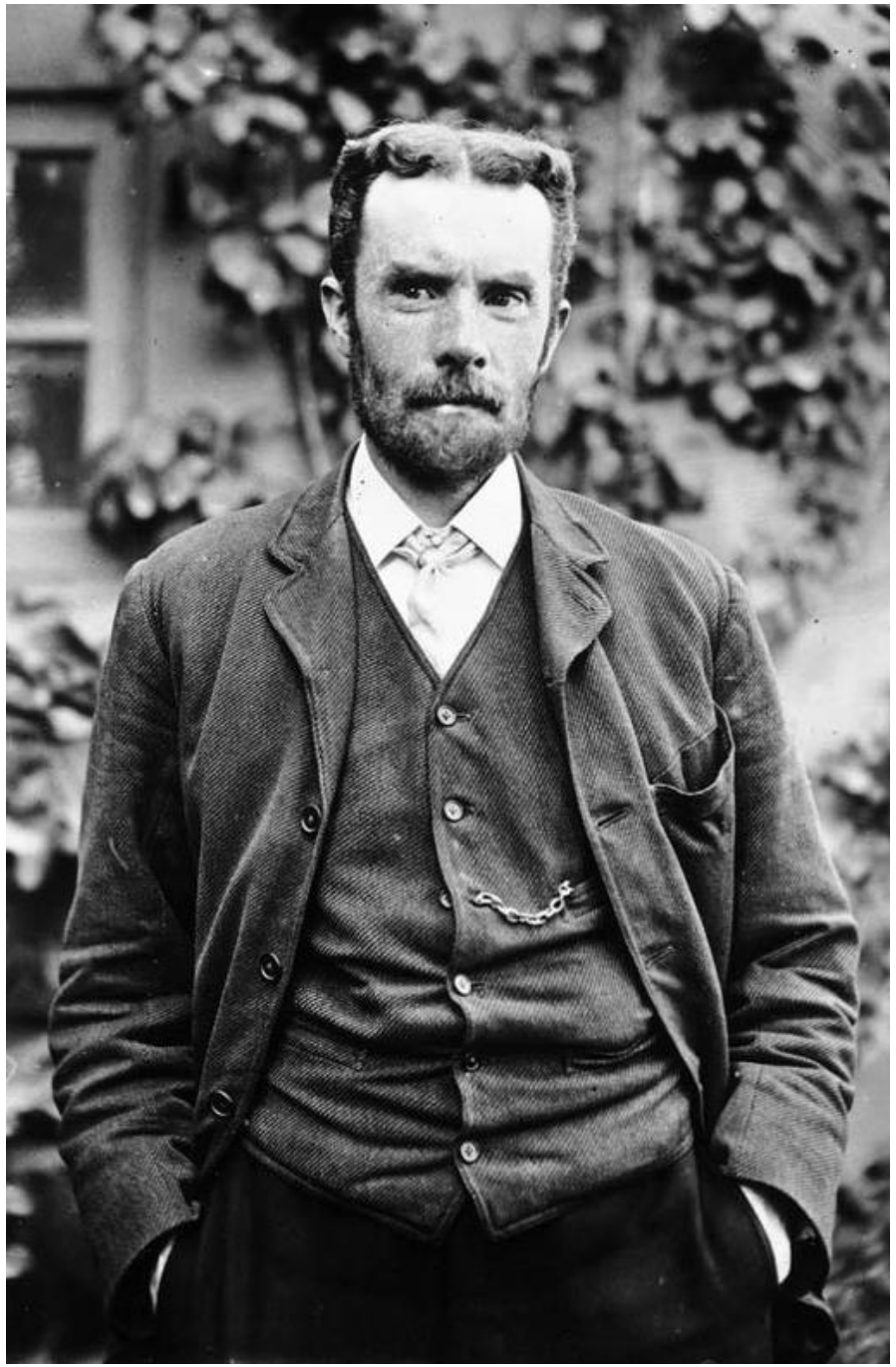
Work contribution

- Euler
- Fourier
- **Laplace**



Work contribution

- Euler
- Fourier
- Laplace
- **Oliver Heaviside**



Work contribution

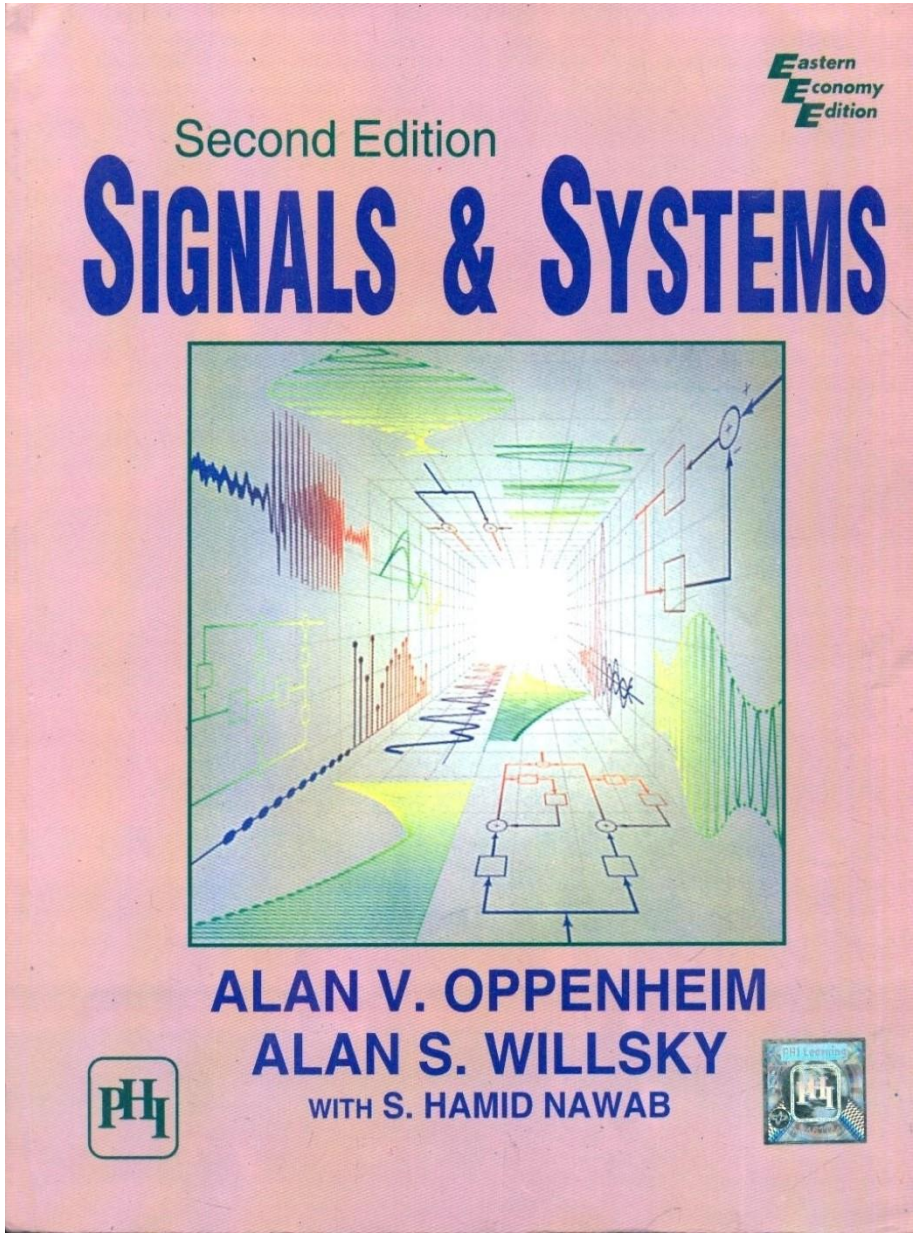
- Euler
- Fourier
- Laplace
- Oliver Heaviside
- **Dirichlet**

Syllabus

Units	Topics	# of Lectures
I	Introduction to Signals and Systems	4
II	Linear Time Invariant Systems	8
III	Fourier Series Representation of S&S	5
IV	Continuous-time Fourier Transform	5
V	Discrete-time Fourier Transform	7
VI	Sampling	5
VII	The Laplace Transform	4
VIII	The Z Transform	4
	Total number of Lectures	42

TEXT Book

Alan V. Oppenheim, A. S. Willsky, and S. Hamid Nawab, “Signals & Systems,” PHI, Second Edition.



Evaluation pattern

Minor: 30
Major: 45
Quizzes (10): 10
Projects: 15

Audit pass $\geq 30\%$

No attendance policy

Tutorials

- On Tuesday, Thursday, Friday and Monday
  - **2-3 pm**
- Problem sheets will be uploaded in Moodle

Other support

- **Dr. Abhishek Dixit**

IIA (Bharti School)-312, (meet me by appointment)

Email: abhishek.dixit@iitd.ac.in Phone number: 011-26596301

- **Piazza**

Sign up on Piazza: piazza.com/iit_delhi/spring2022/ell205

Access code: ell205

- **You can ask for extra class by emails or by Piazza.**

What do we learn in this course?

- Language of describing signals and systems
- Analysing signals and systems
- Observing signals and systems


Fs: 48000 Hz
M1: -
Window: Hanning
M2: -
FFT size: 2048
0
-20
-40
-60
-80
-100
-120
dbFS
93 Hz
140 Hz
1.2 kHz
100
500
1k
2k
5k
10k
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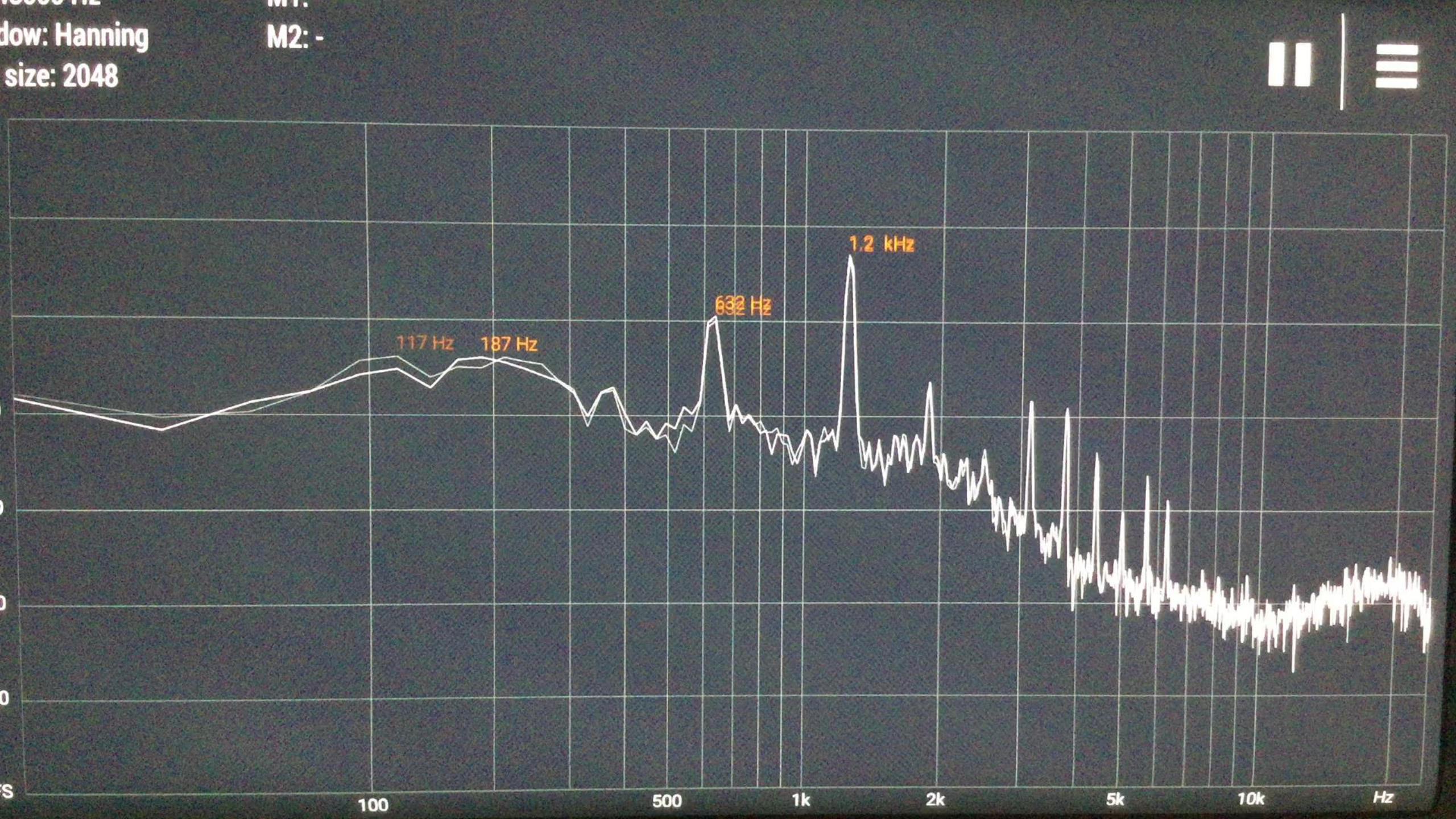
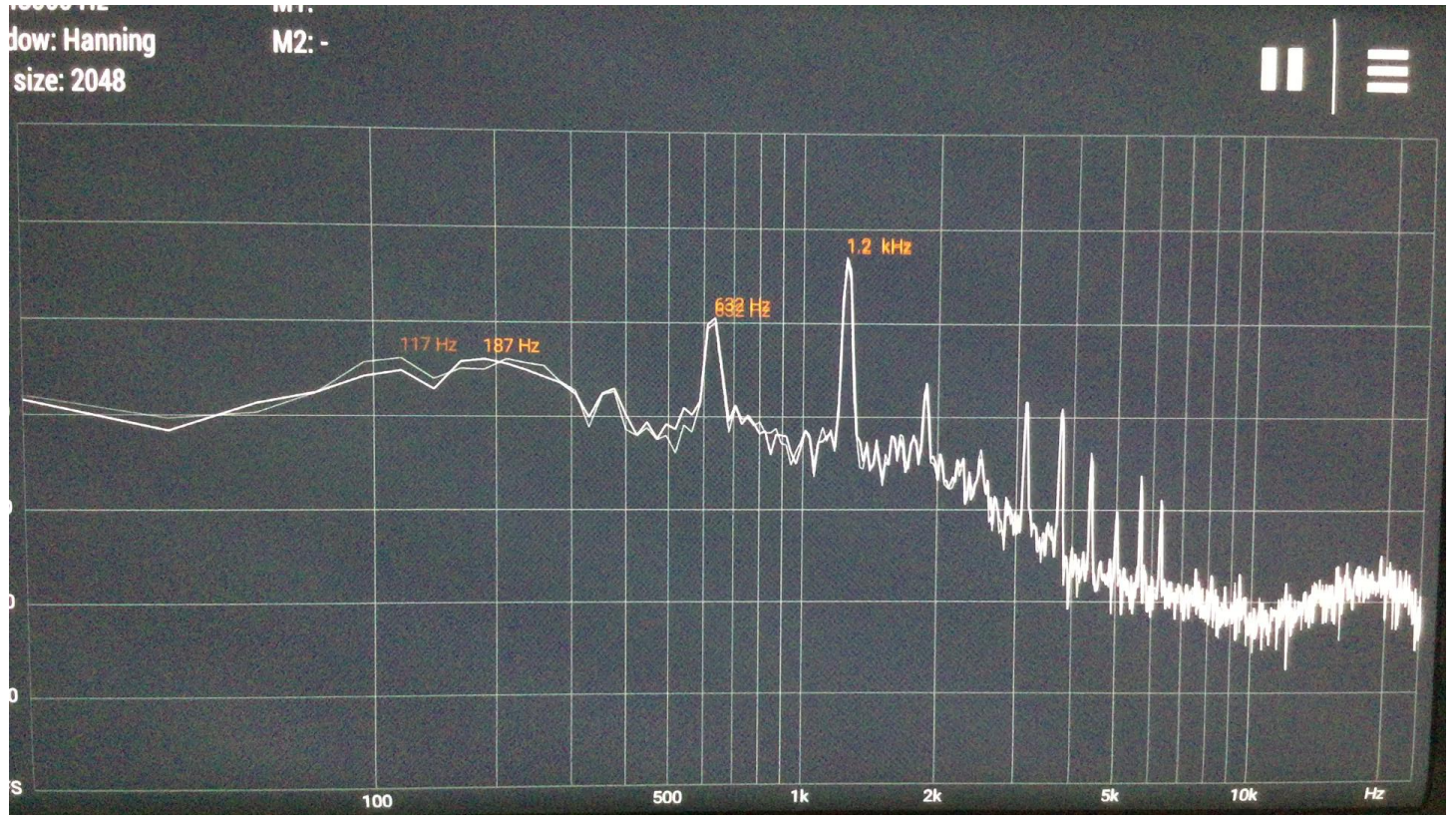

dow: Hanning
size: 2048
M2: -
1.2 kHz
632 Hz
117 Hz
187 Hz
100
500
1k
2k
5k
10k
Hz


dow: Hanning
size: 2048
M2: -
1.2 kHz
632 Hz
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100
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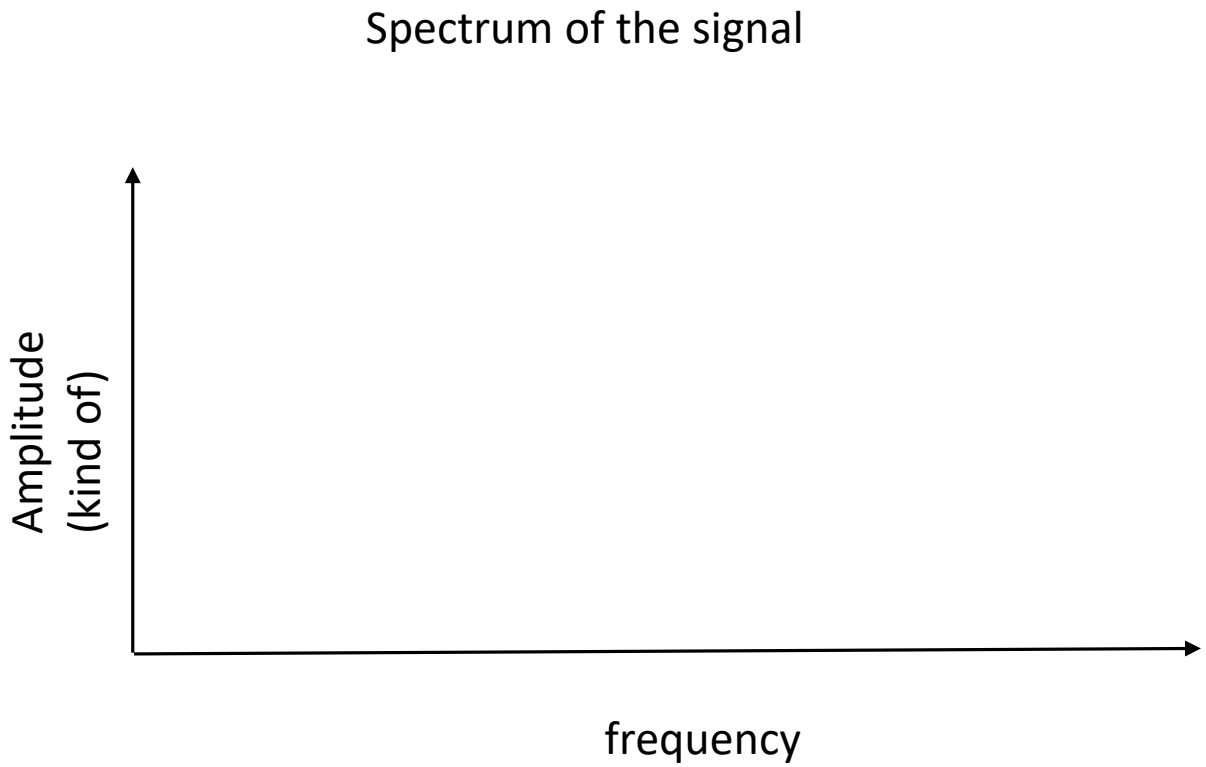
What do we see?



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Different sounds corresponds to different spectrum.

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Instrument produces higher frequencies than human.

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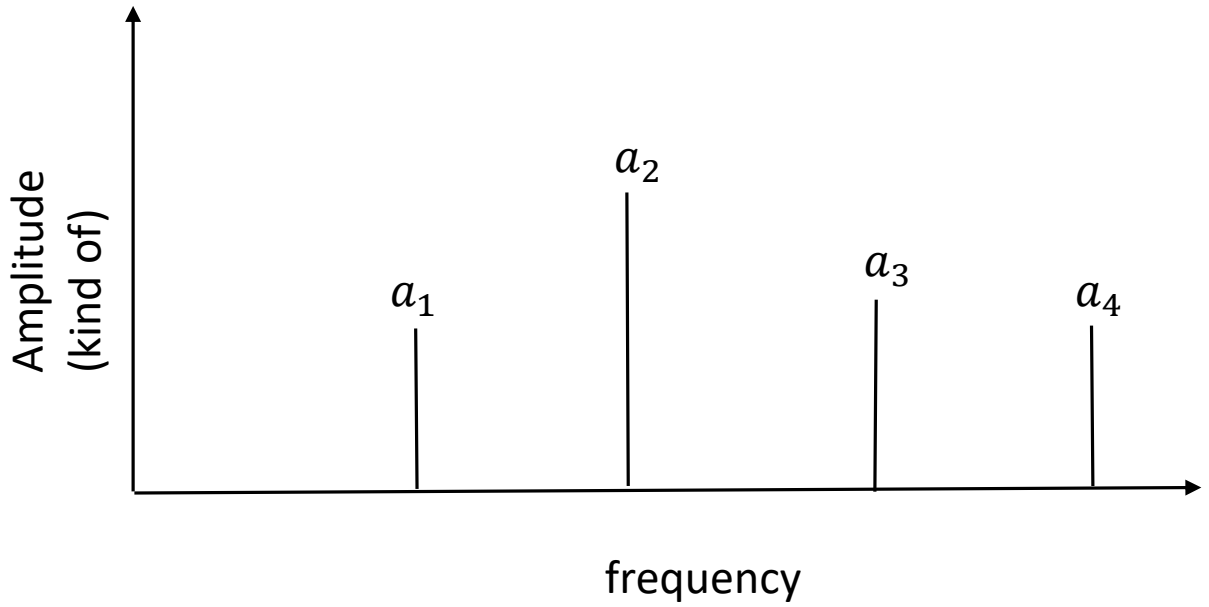
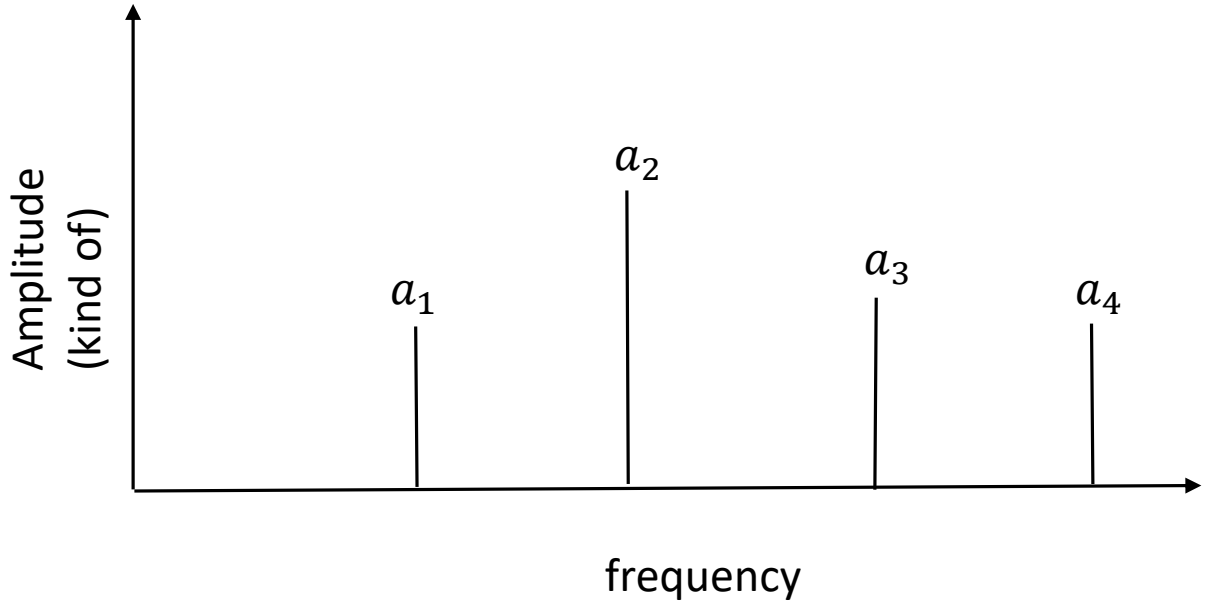
Instrument produces higher frequencies than human.
Each instrument has a different timbre (ratio of spectral components).



What do we see?

Different sounds corresponds to different spectrum.
Instrument produces higher frequencies than human.
Each instrument has a different timbre (ratio of spectral components)
Sharper sounds has a larger difference between the spectral components.



What are signals and systems?