Feature: Individual measurable property or characteristic of a phenomenon being observed

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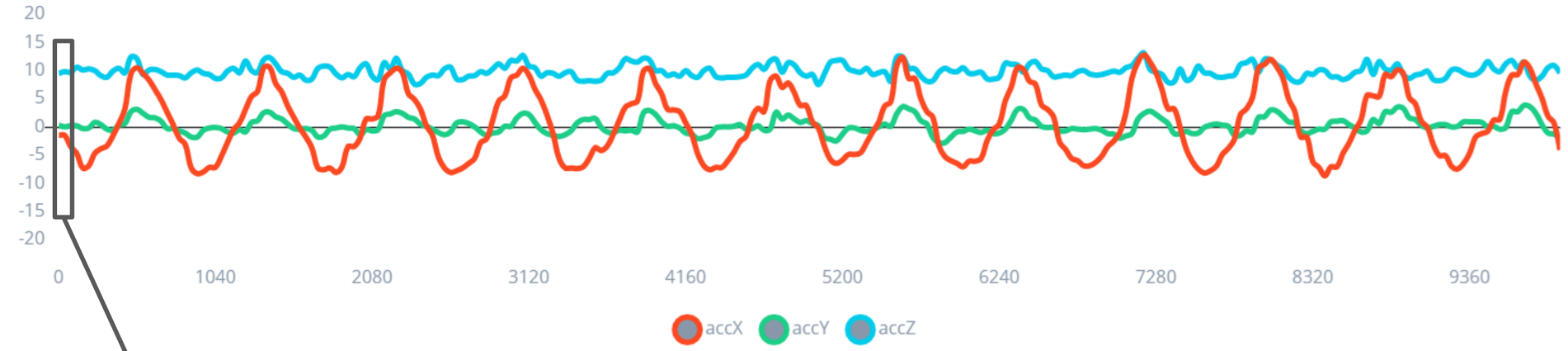
Feature Example



Acceleration (m/s^2)

x	-1.4
y	0.4
z	9.6

Model

- Left-right
- Up-down
- Circle
- Idle

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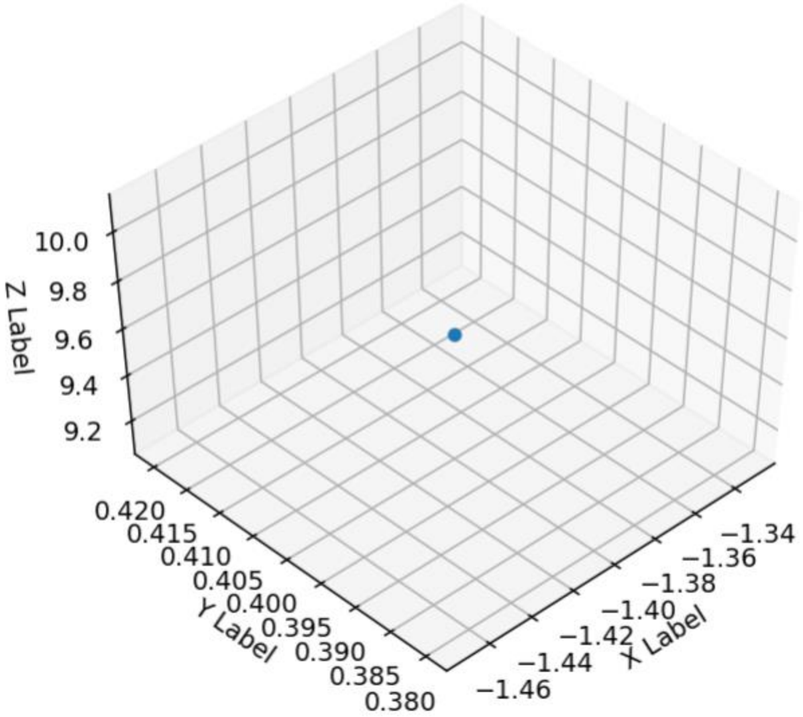
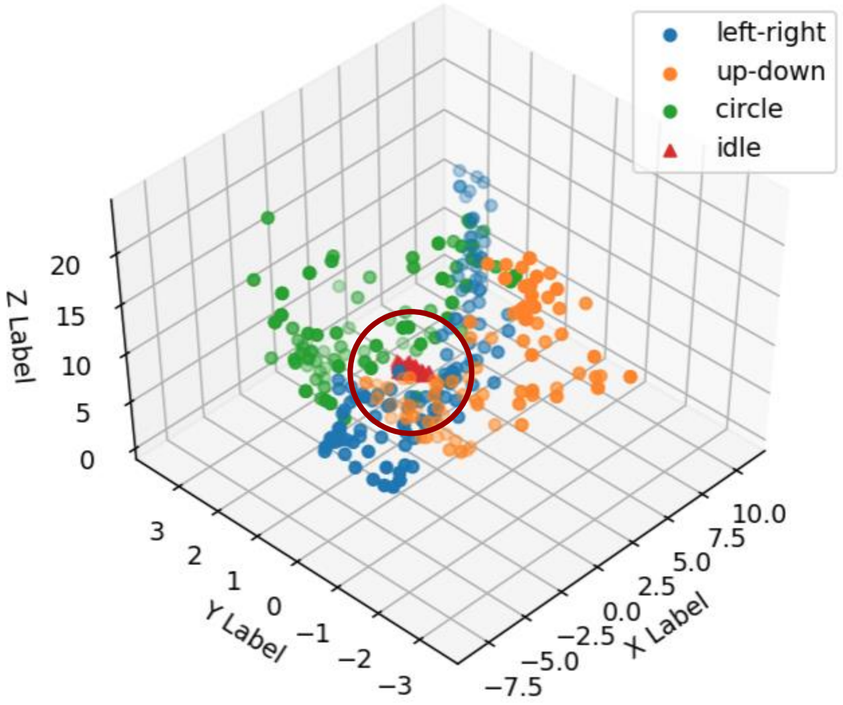
1 (x, y, z) accelerometer point
from “left-right” sample



Many (x, y, z) accelerometer
points from all classes



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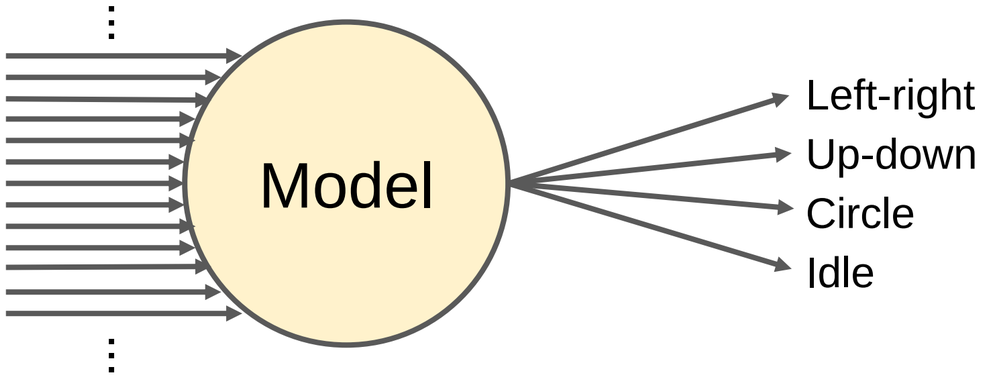
Feature Example

Acceleration (m/s^2)

x	-1.4	-1.4	-2.8	-3.4	-4.0	···
y	0.4	0.4	0.1	0.2	0.3	···
z	9.6	9.6	9.9	9.7	9.8	···

125 samples for each axis



375 total inputs to the model!

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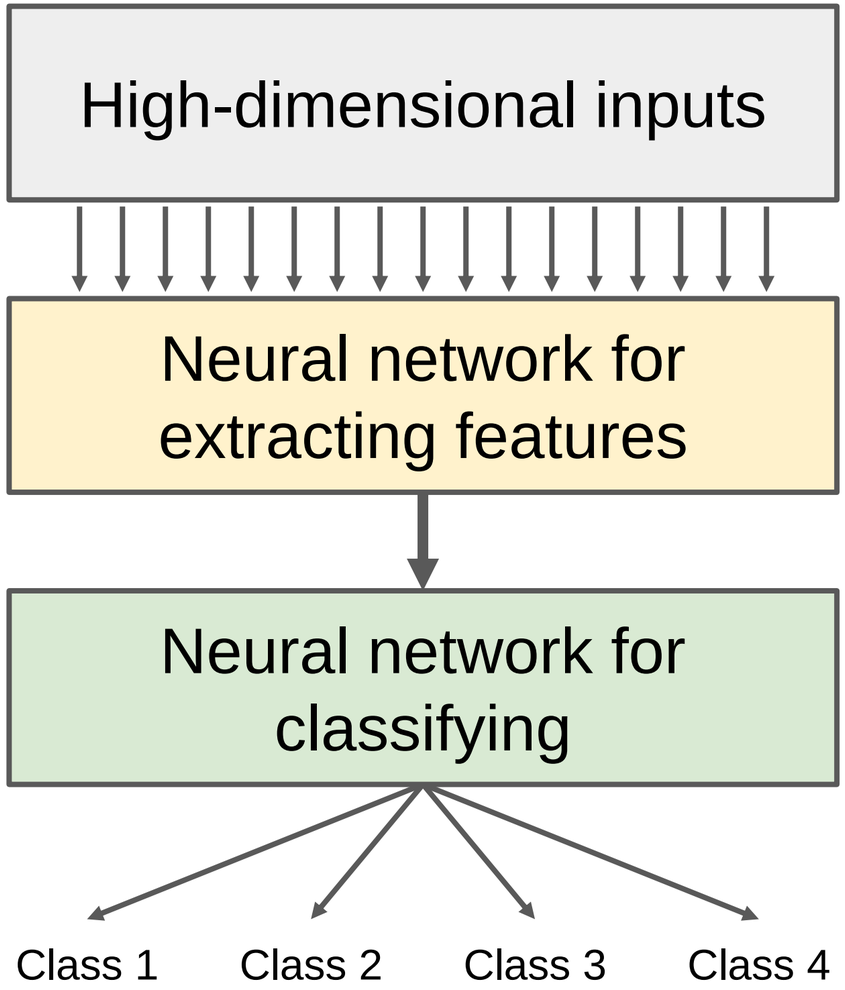
Problems with deep learning

1. Computational complexity
2. Requires lots of training data



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Feature Example

Acceleration (m/s^2)

x	-1.4	-1.4	-2.8	-3.4	-4.0	...
y	0.4	0.4	0.1	0.2	0.3	...
z	9.6	9.6	9.9	9.7	9.8	...

375 raw values

Feature extraction: Calculate RMS for each axis

x_{RMS} = 5.7 m/s^2 (RMS)

y_{RMS} = 1.2 m/s^2 (RMS)

z_{RMS} = 9.9 m/s^2 (RMS)

3 model input values

Model

- Left-right
- Up-down
- Circle
- Idle

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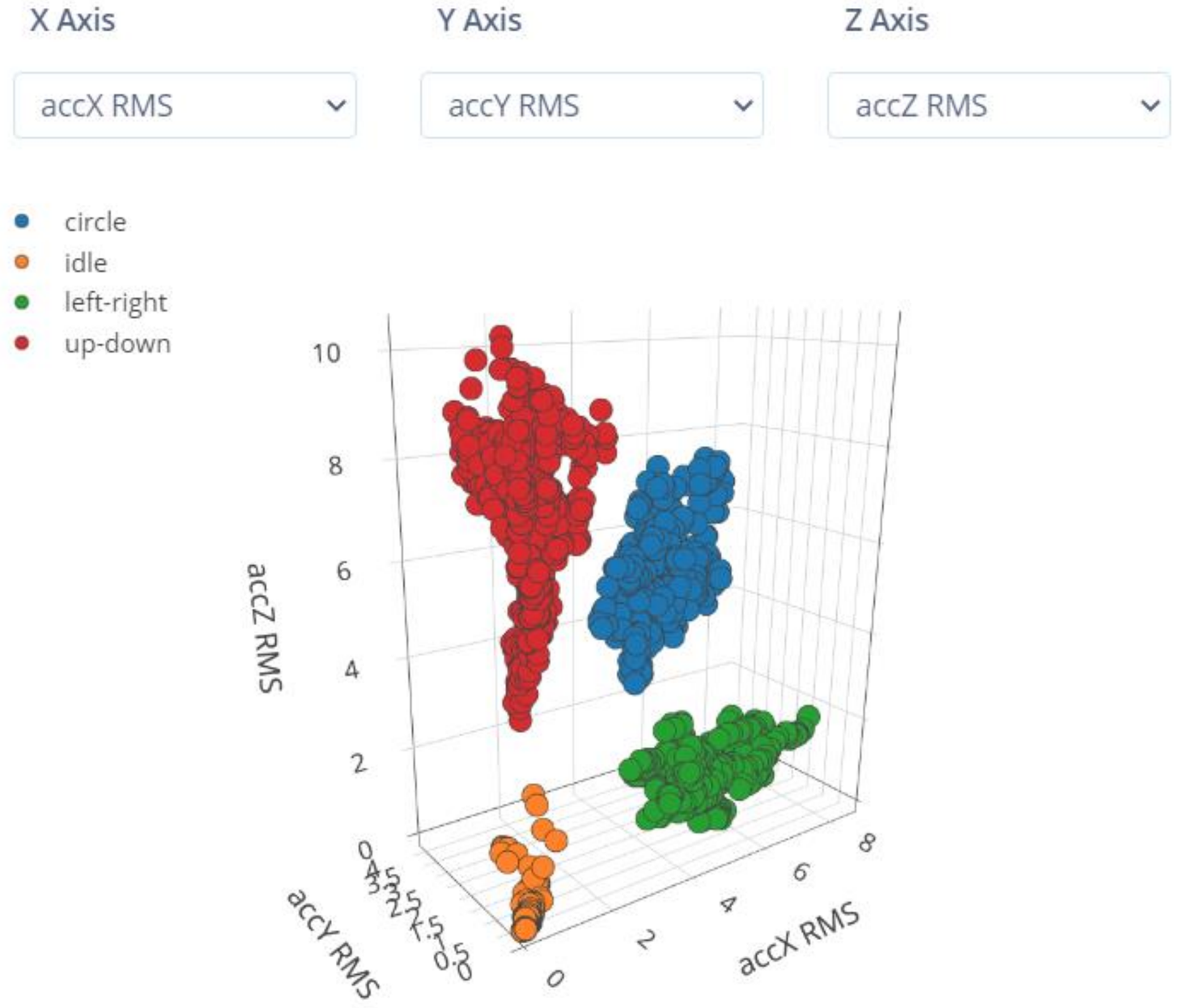

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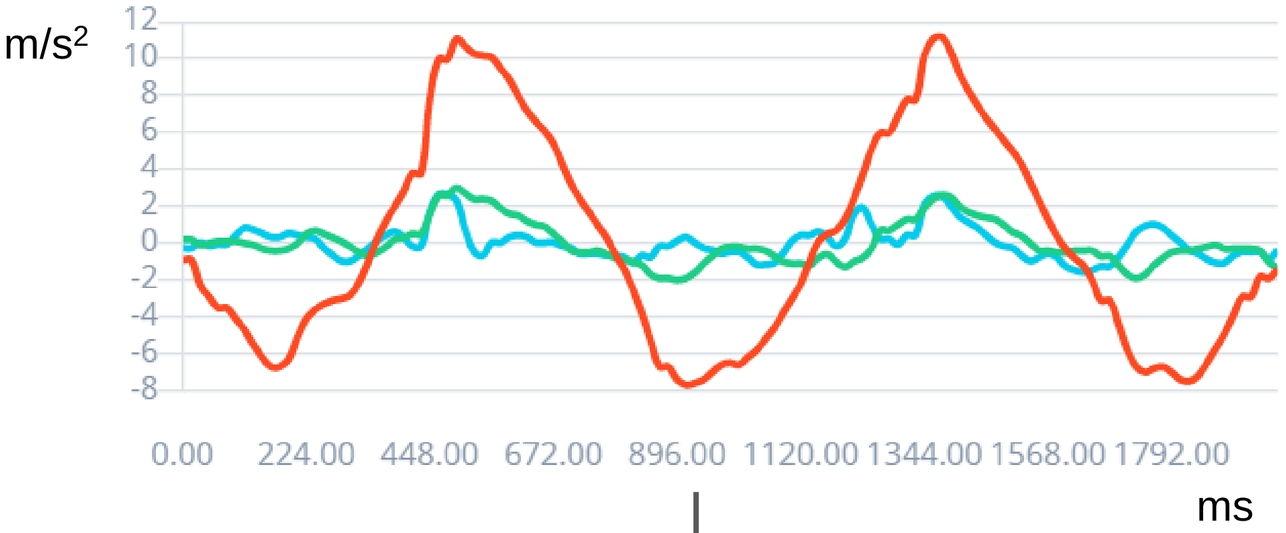
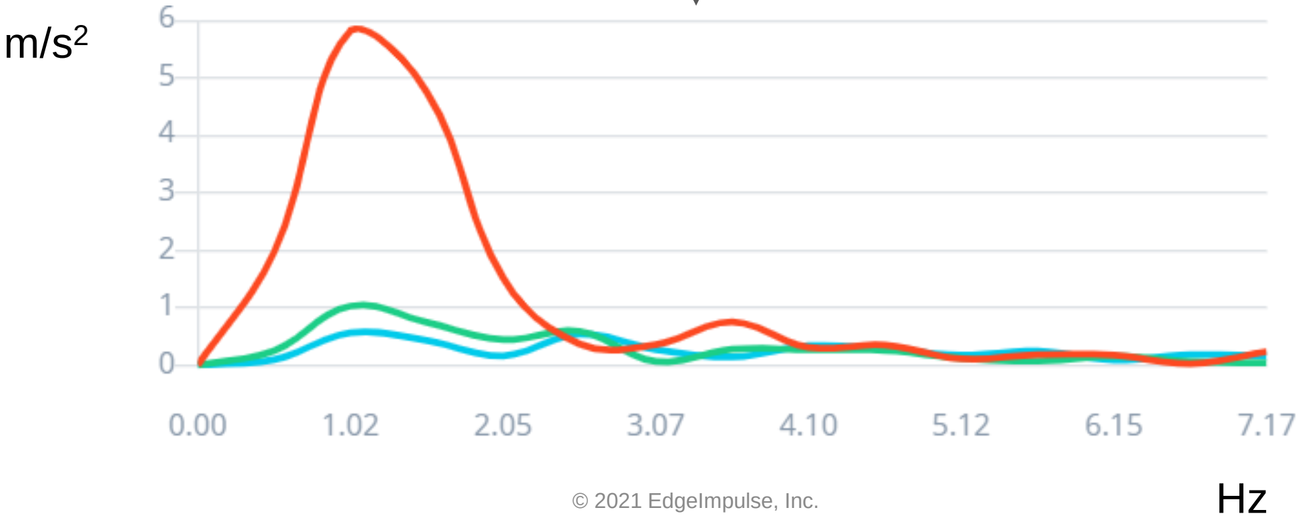


Time domain

Feature extraction:
FFT



Frequency domain

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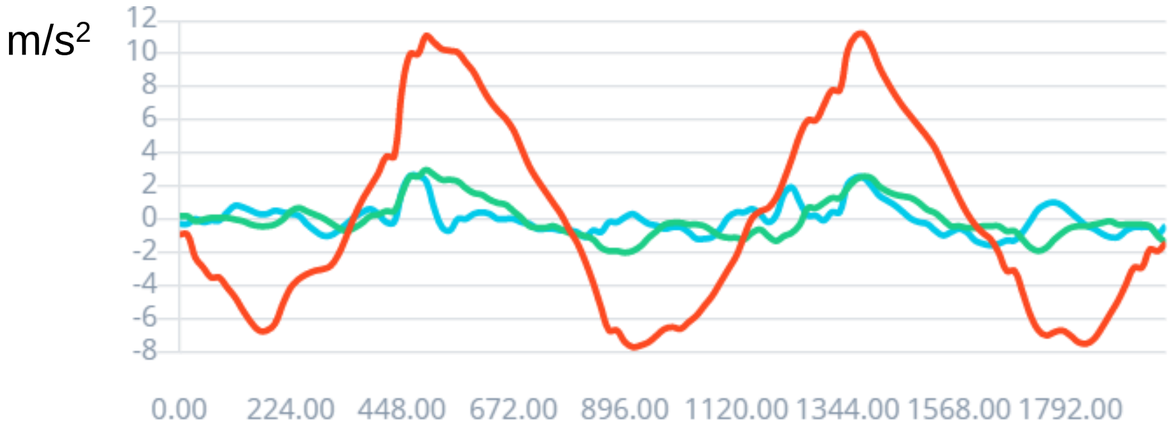
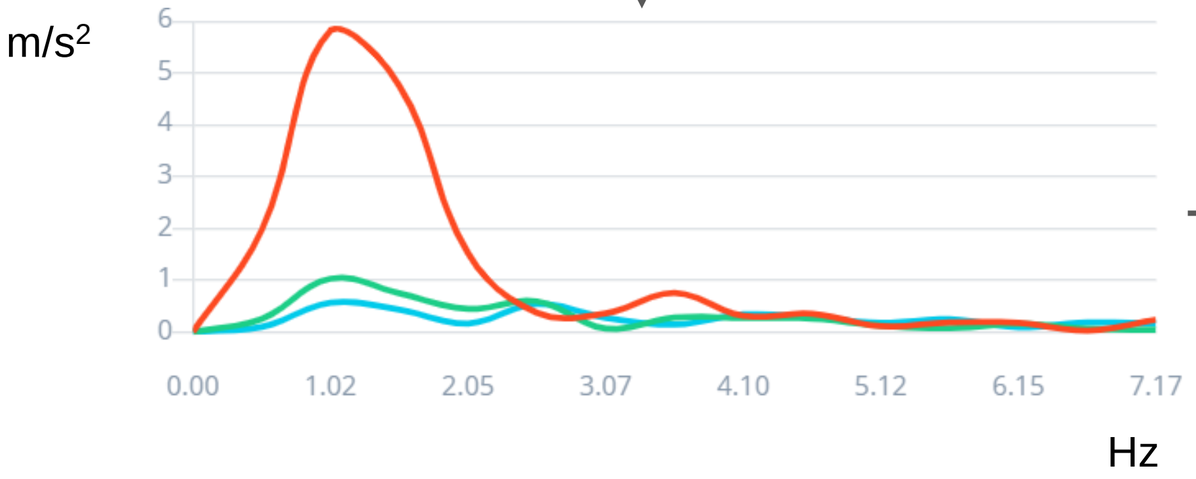
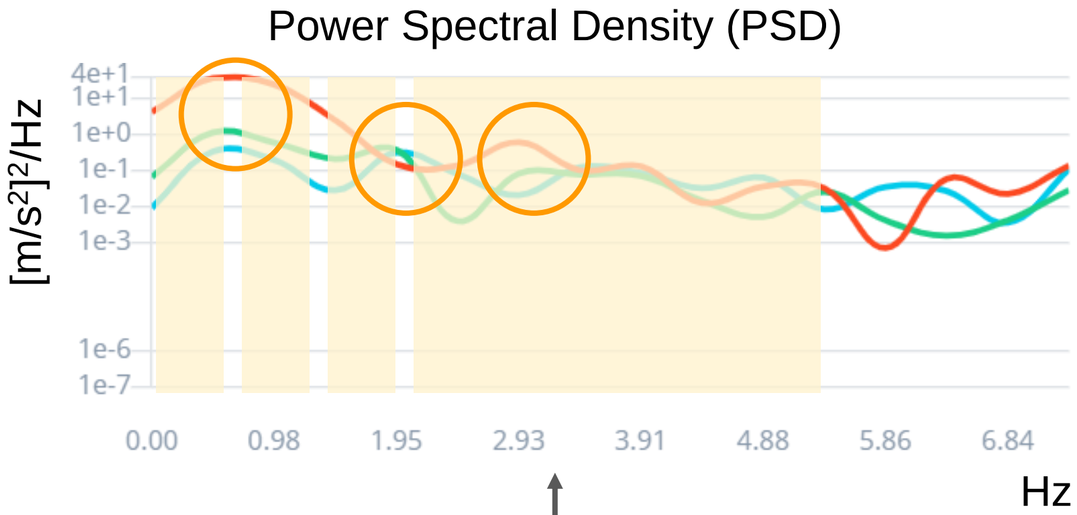


Feature extraction: FFT





Feature extraction: PSD

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Feature Example

Acceleration (m/s^2)

x	-1.4	-1.4	-2.8	-3.4	-4.0	...
y	0.4	0.4	0.1	0.2	0.3	...
z	9.6	9.6	9.9	9.7	9.8	...

375 raw values

Feature extraction: RMS and Power Spectral Density (PSD)

11 features per axis: RMS, 3x peak amplitudes from PSD, 3x peak frequencies from PSD, 4x spectral bins

33x features

Model

- Left-right
- Up-down
- Circle
- Idle

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Feature Example

Acceleration (m/s^2)

x	-6.8	-5.6	-4.6	-4.1	-3.8	...
y	-0.1	0.2	0.7	0.9	0.7	...
z	10.4	10.3	10.2	10.1	9.6	...

375 raw values

Feature extraction:
RMS and Power Spectral Density (PSD)

11 features per axis: RMS, 3x peak amplitudes from PSD, 3x peak frequencies from PSD, 4x spectral bins

33x features

Model

- Left-right
- Up-down
- Circle
- Idle

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