

Feature Extraction from Motion Data

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

Feature Example



Qual movimento é dado pelo seguinte gráfico de dados brutos do acelerômetro?

Dica: o eixo X vai da esquerda para a direita, o eixo Y vai para frente e para trás, o eixo Z vai para cima e para baixo.

Esquerda-direita

Círculo

Cima-baixo

Ocioso



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Esquerda-direita

Círculo

Cima-baixo

Ocioso



O movimento para frente e para trás no eixo X é o movimento "esquerda-direita".

Feature Example



Acceleration (m/s^2)

x	-1.4
y	0.4
z	9.6

Feature Example

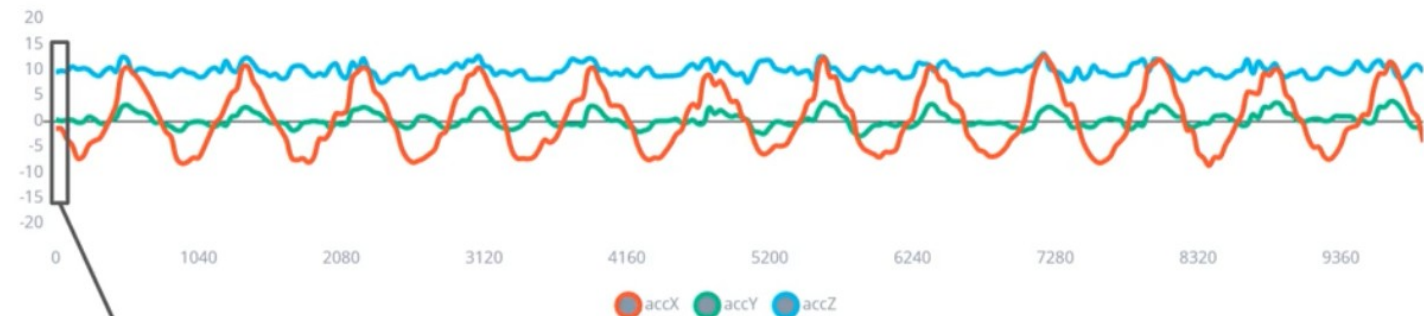


Acceleration (m/s^2)

x	-1.4
y	0.4
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Model

Feature Example



Acceleration (m/s^2)

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Model

Left-right
Up-down
Circle
Idle

Usar um único valor instantâneo no tempo dos valores brutos do acelerômetro é um bom conjunto de recursos para o nosso modelo.

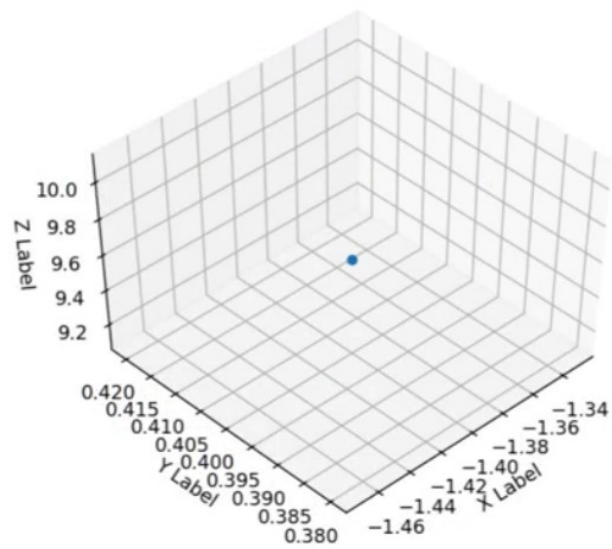
Verdadeiro ou Falso

Usar um único valor instantâneo no tempo dos valores brutos do acelerômetro é um bom conjunto de recursos para o nosso modelo.

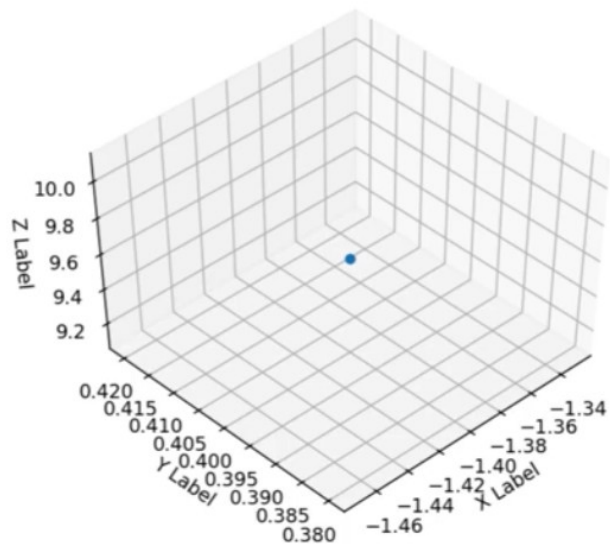
Verdadeiro ou Falso

Um única amostra instantânea no tempo não leva em conta como os dados variam ao longo do tempo.

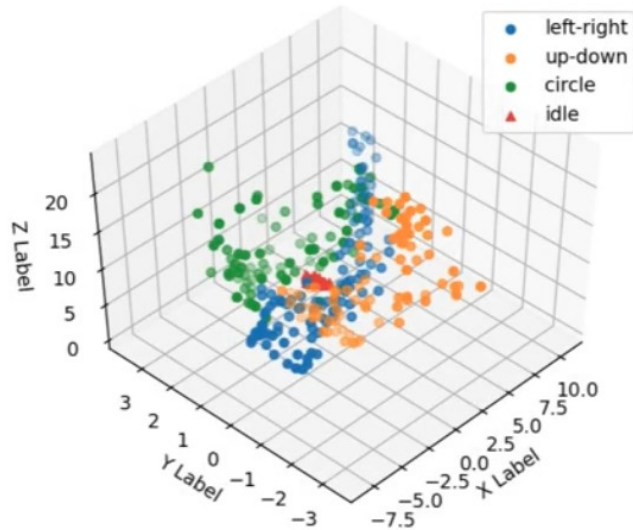
1 (x, y, z) accelerometer point
from "left-right" sample



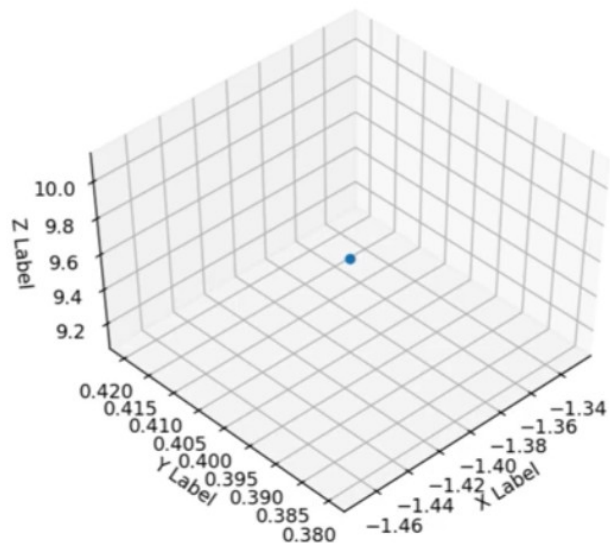
1 (x, y, z) accelerometer point
from "left-right" sample



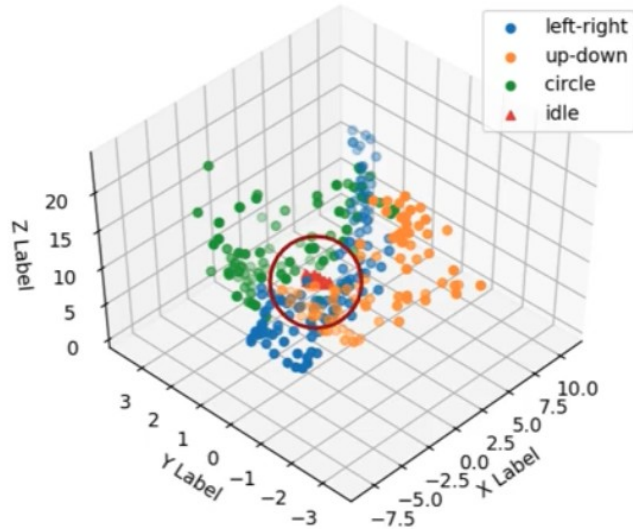
Many (x, y, z) accelerometer points
from all classes



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



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

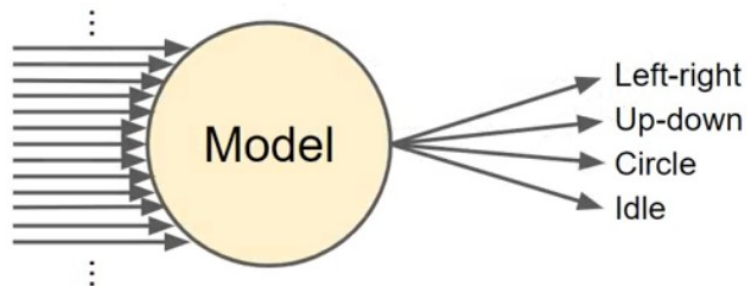


Feature Example



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	...



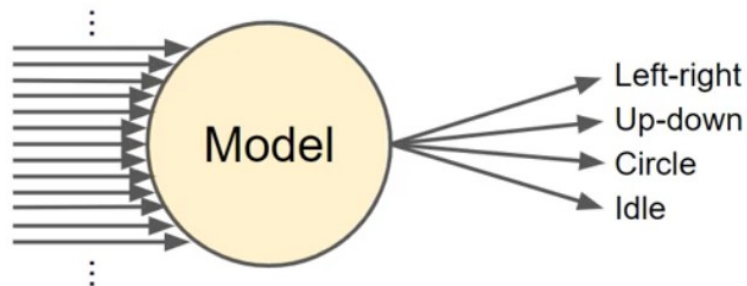
Feature Example



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



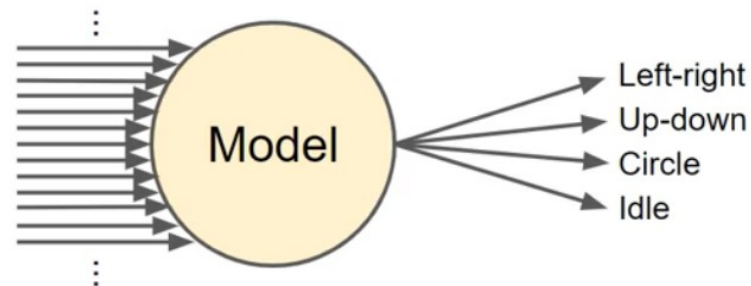
Feature Example



Acceleration (m/s^2)

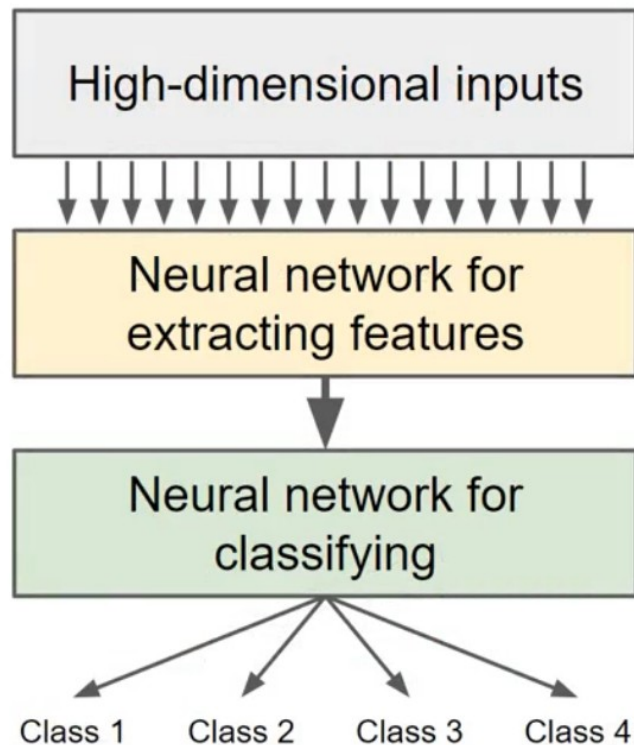
x	-1.4	-1.4	-2.8	-3.4	-4.0	...
y	0.4	0.4	0.1	0.2	0.3	...
z	9.6	9.6	9.9	9.7	9.8	...

125 samples for each axis



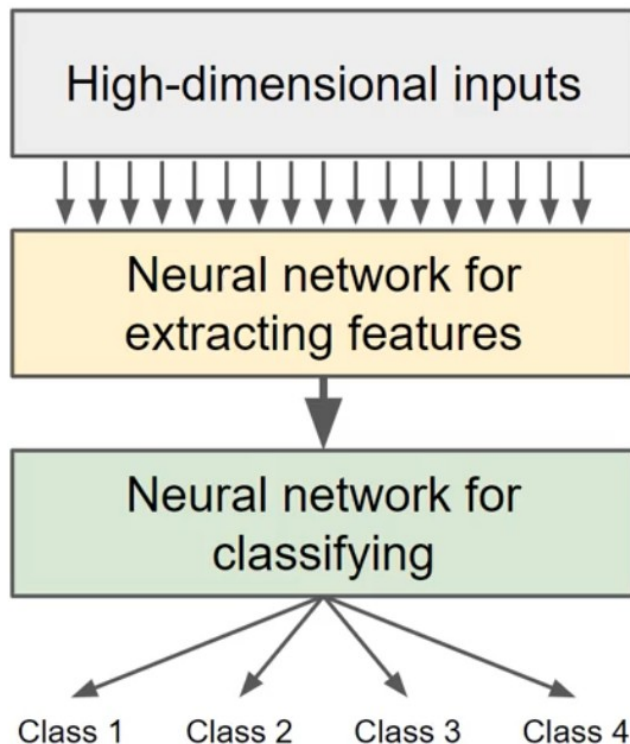
375 total inputs to the model!

Problems with deep learning



Problems with deep learning

1. Computational complexity
2. Requires lots of training data

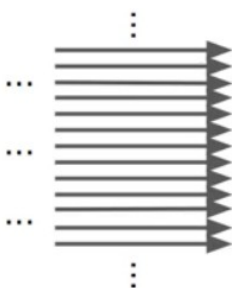


Feature Example



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	...



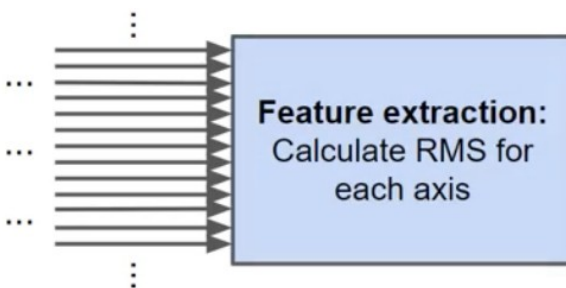
375 raw values

Feature Example



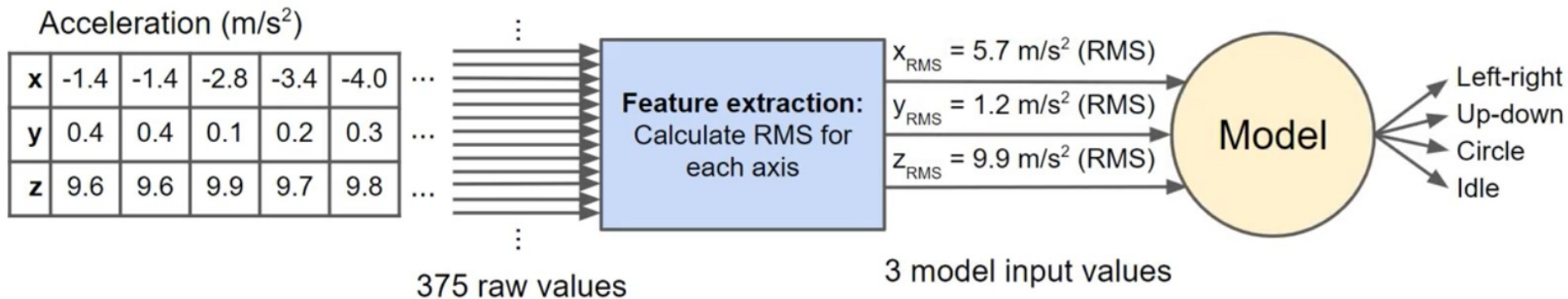
Acceleration (m/s^2)

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 Example



X Axis

accX RMS



Y Axis

accY RMS

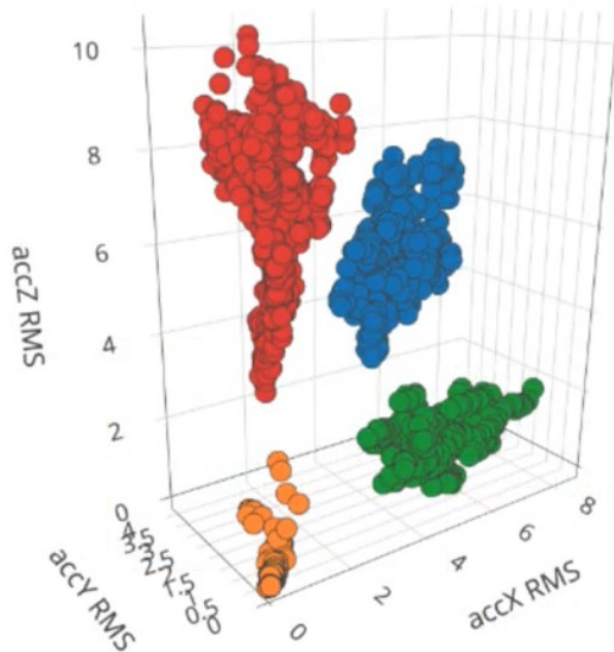


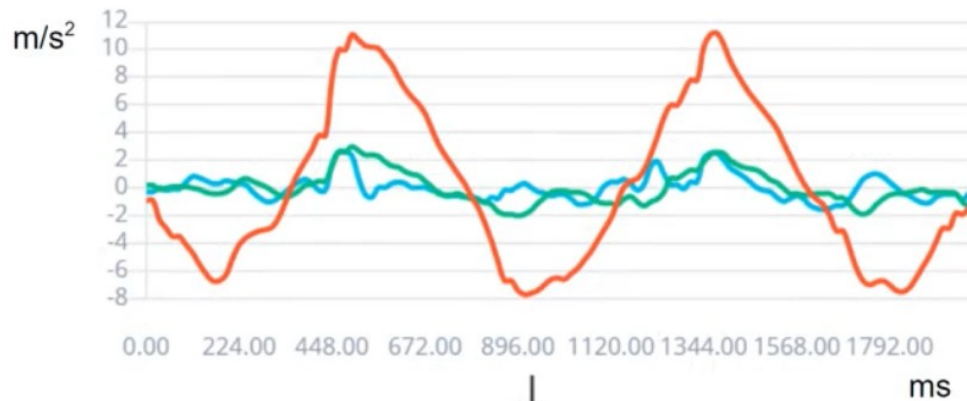
Z Axis

accZ RMS

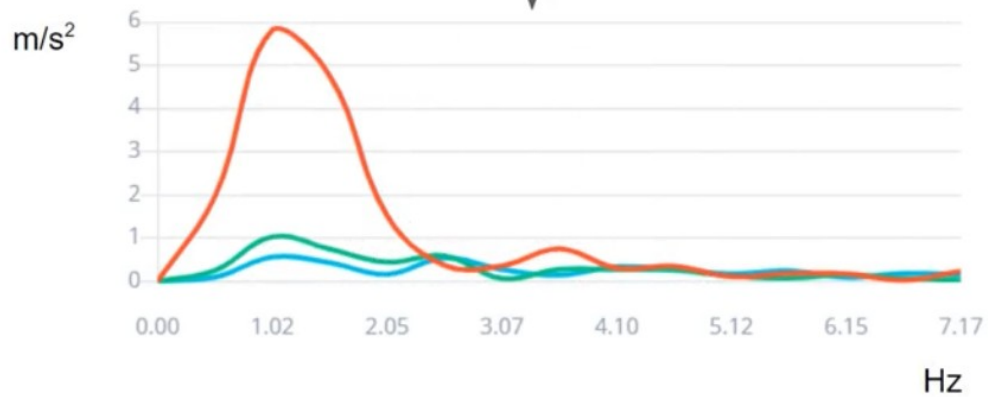
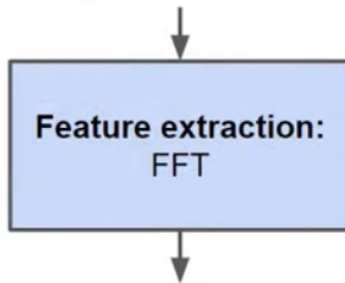


- circle
- idle
- left-right
- up-down

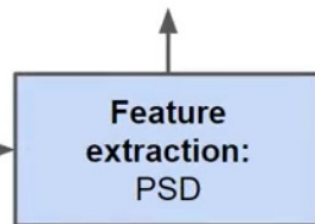
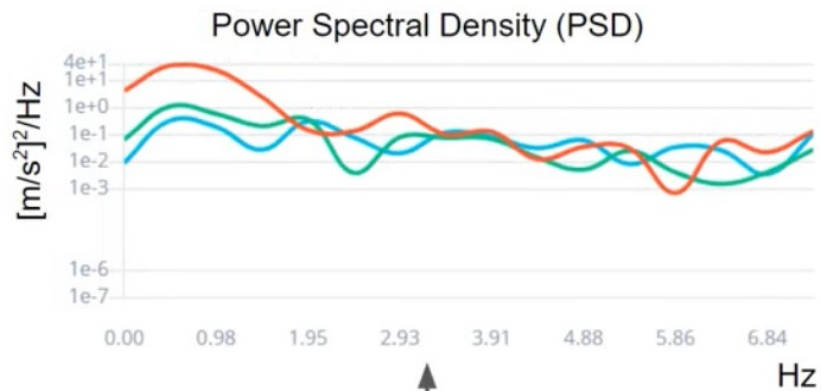
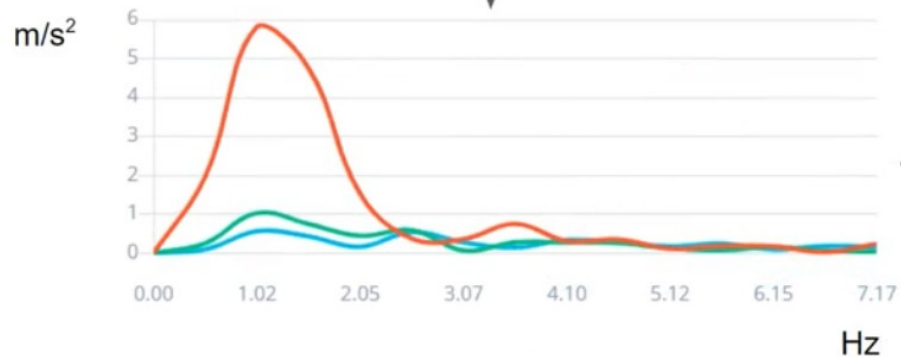
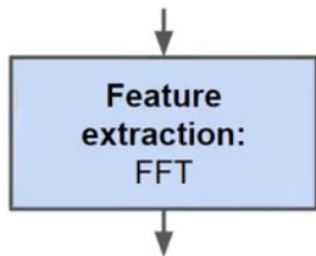
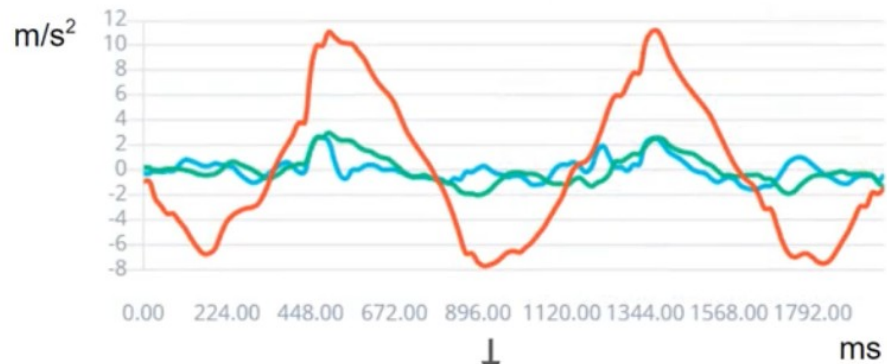


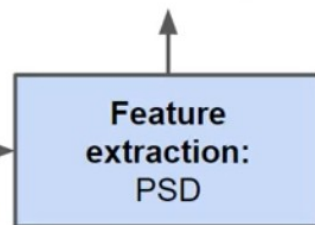
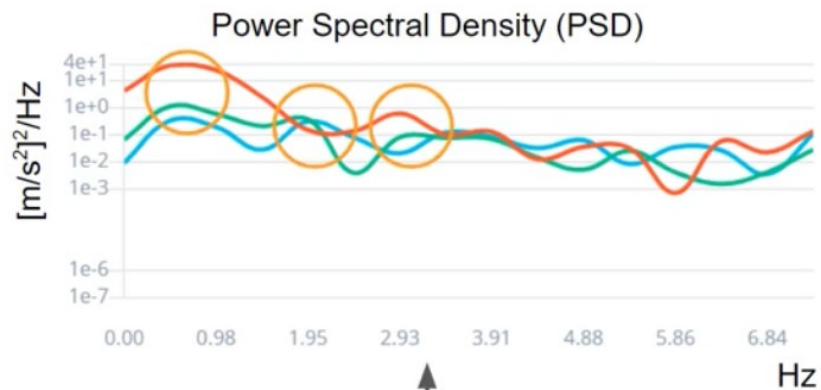
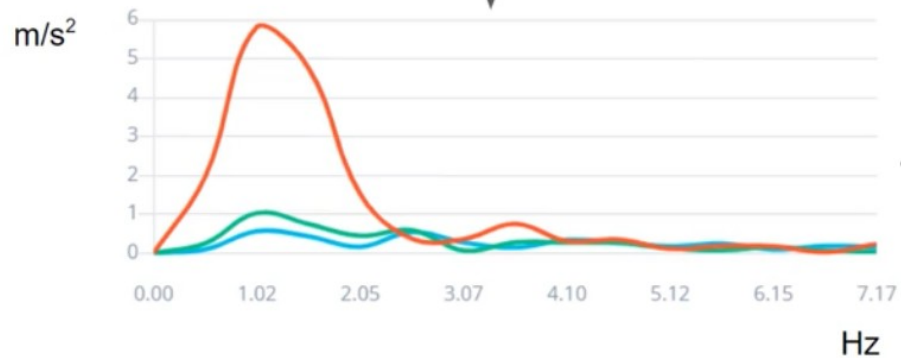
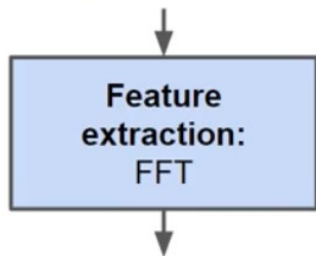
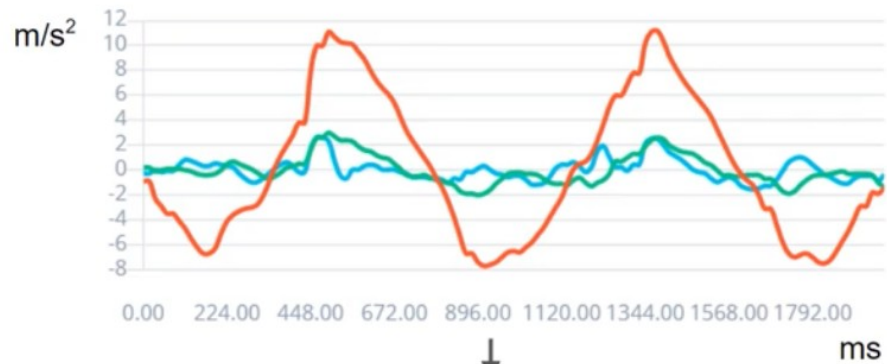


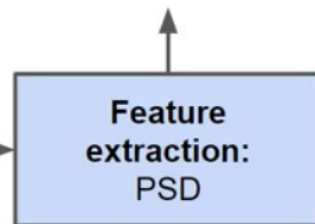
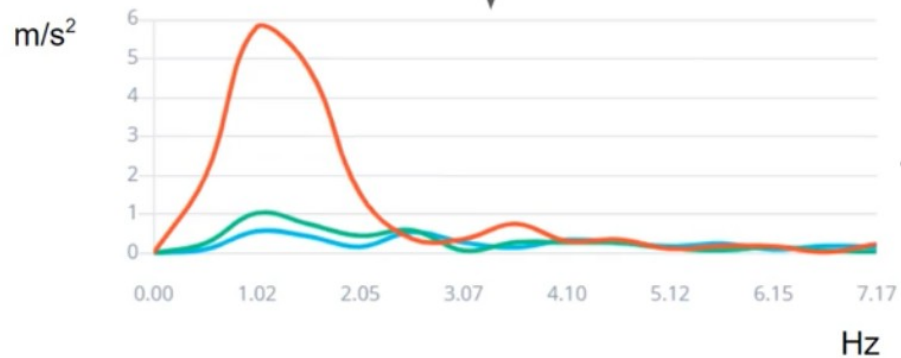
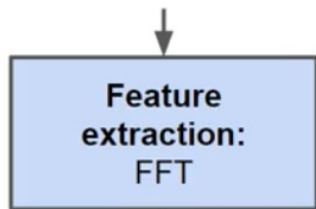
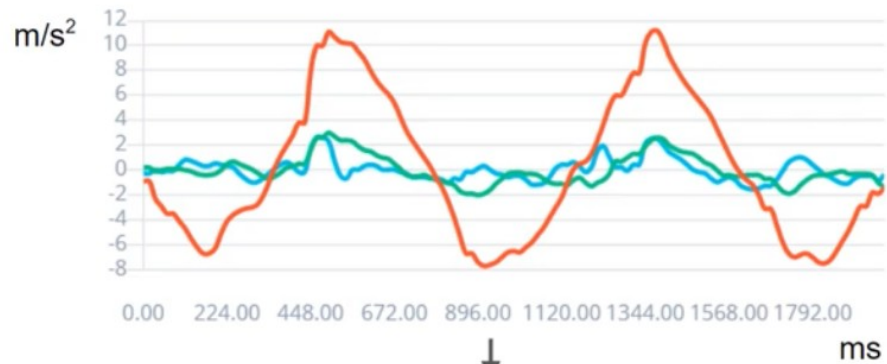
Time domain



Frequency domain







Feature Example



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

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)

33x features

Model

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

Feature Example



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

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)

33x features

Model

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

Embora seja opcional, recomendo que você dê uma olhada nos artigos e vídeos a seguir para saber mais sobre os tópicos abordados:

- [Seleção e extração de características no aprendizado de máquina: Uma visão geral](#)
- [Qual é a diferença entre extração de características e seleção de características?](#)
- [Cálculos de média e raiz quadrada média \(RMS\)](#)
- [Mas o que é a transformada de Fourier? Uma introdução visual.](#)
- [Por que a densidade espectral de potência \(PSD\) é o padrão ouro da análise de vibração?](#)