DSP on Android

...

TAG DSP
&
TAG CPS

Outline

1. How do you get sensor data off the phone?
2. What does this data look like?
3. What is resampling?
4. How do you suppress noise?
5. How does this help us recognize gestures?
6. How do we make sick beats?

But first, assemble into groups!

(at least one MATLAB installation per group)

Also, download a file explorer app.

It’ll help.

Android Sensor Data Acquisition

Clone this repository and open the following file:

`/presentation/SensorActivityTemplate.java`

Android Sensor Data Acquisition

- `... extends Activity implements SensorEventListener {`
  - Inherit from the “Activity” class
  - Implement all the function required for the “SensorEventListener” class
- `... onSensorChanged()`
  - This is where the magic happens. Think of it like an interrupt handler.
- `... onAccuracyChanged()`
  - Required for SensorEventListener, rarely used
- `... onPause()`
  - Called when the application loses focus
- `... onResume()`
  - Called when the application is brought back into focus

How is SensorReader.java different?

LINEAR_ACCELERATION instead of ACCELERATION?

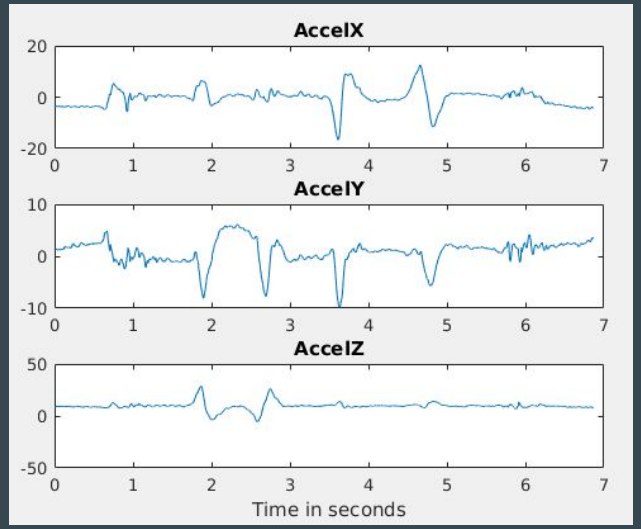
Now collect your own data and figure out your sampling rate!

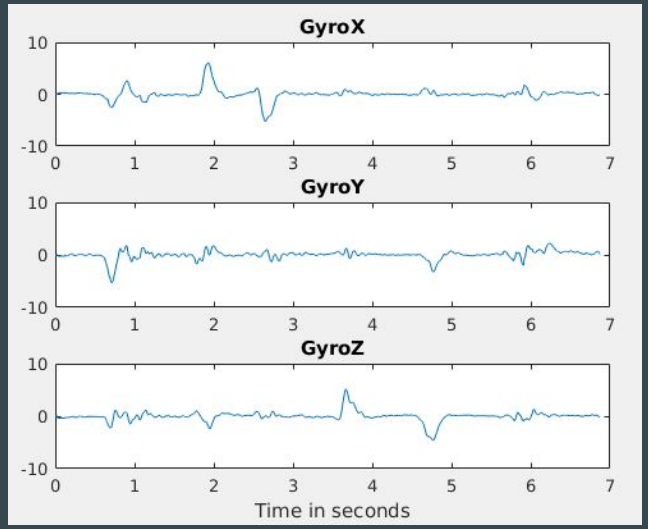
*Comment out the gyroscope acquisition
* Log.d() may be helpful

Visualize data

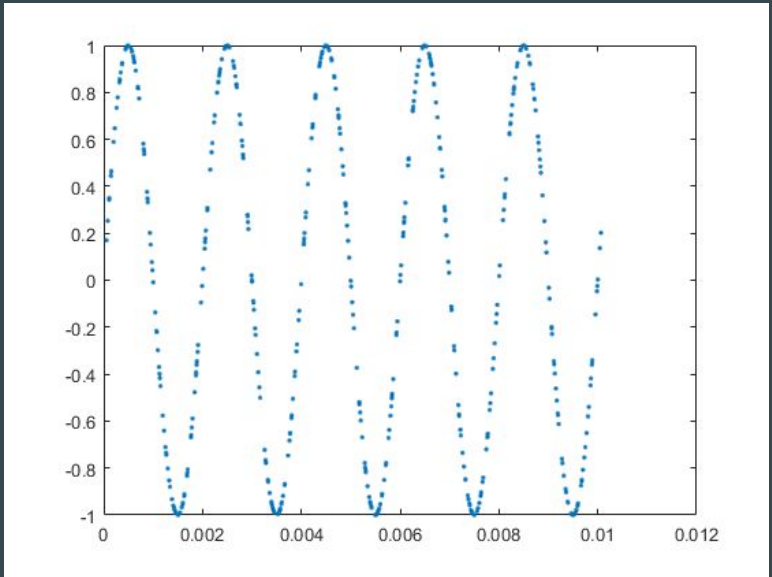
`/scripts/matlab/template/csv_parse.m`

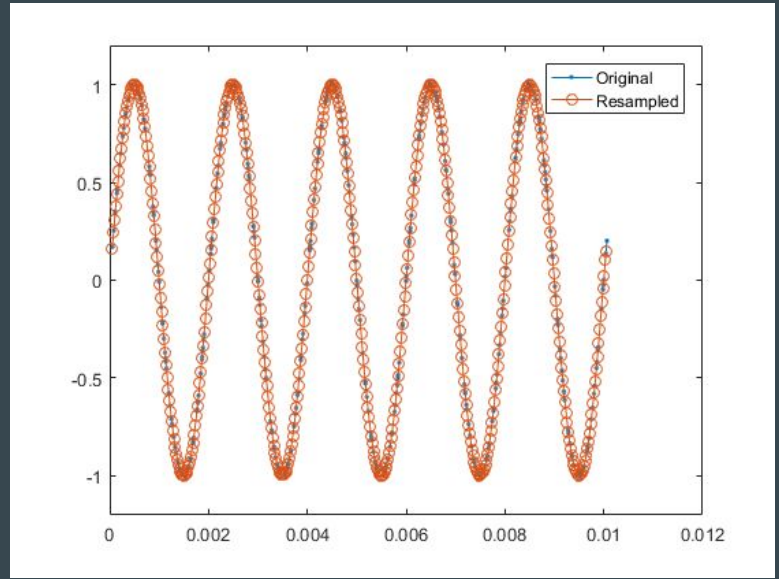
Run the first section to visualize results:



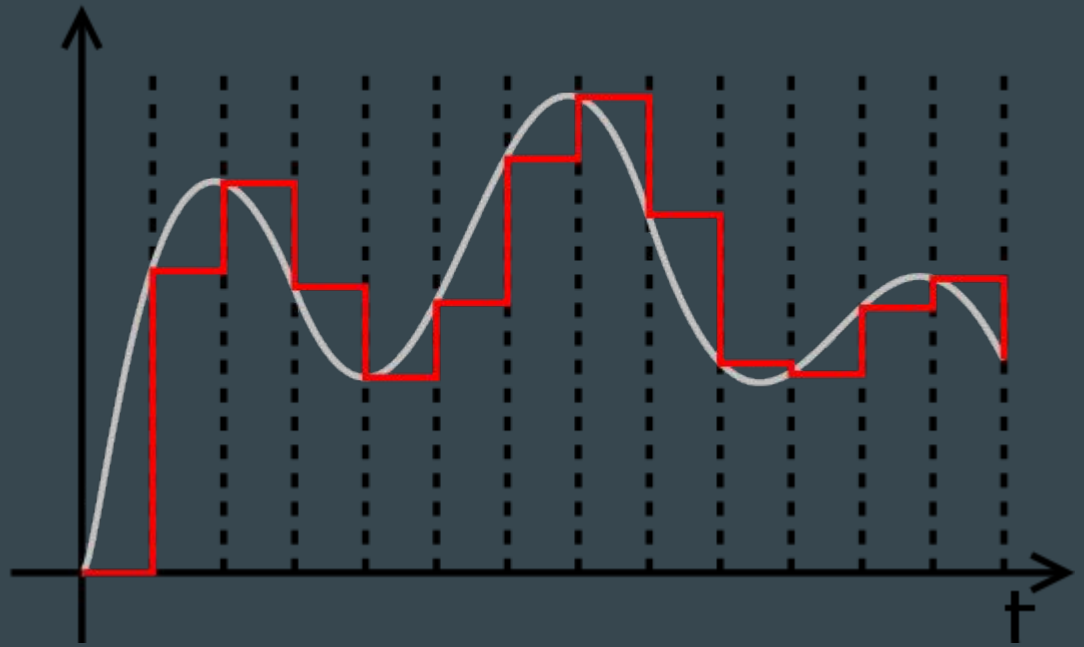


Resampling

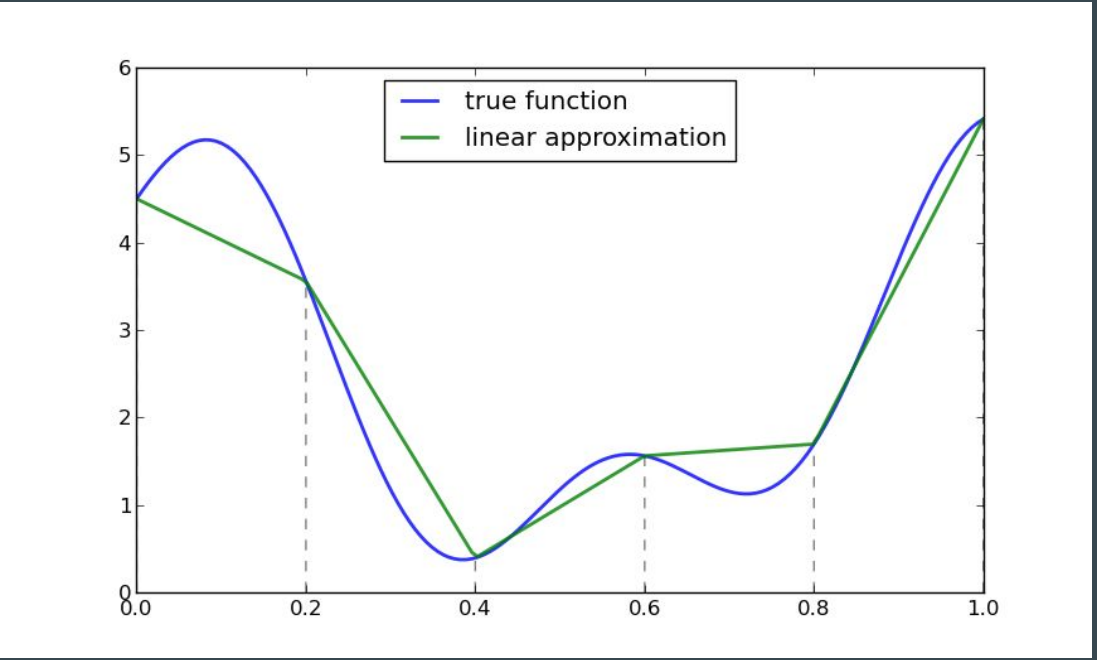

1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0
0.002
0.004
0.006
0.008
0.01
0.012


Original
Resampled
1
0.5
0
-0.5
-1
0
0.002
0.004
0.006
0.008
0.01
0.012

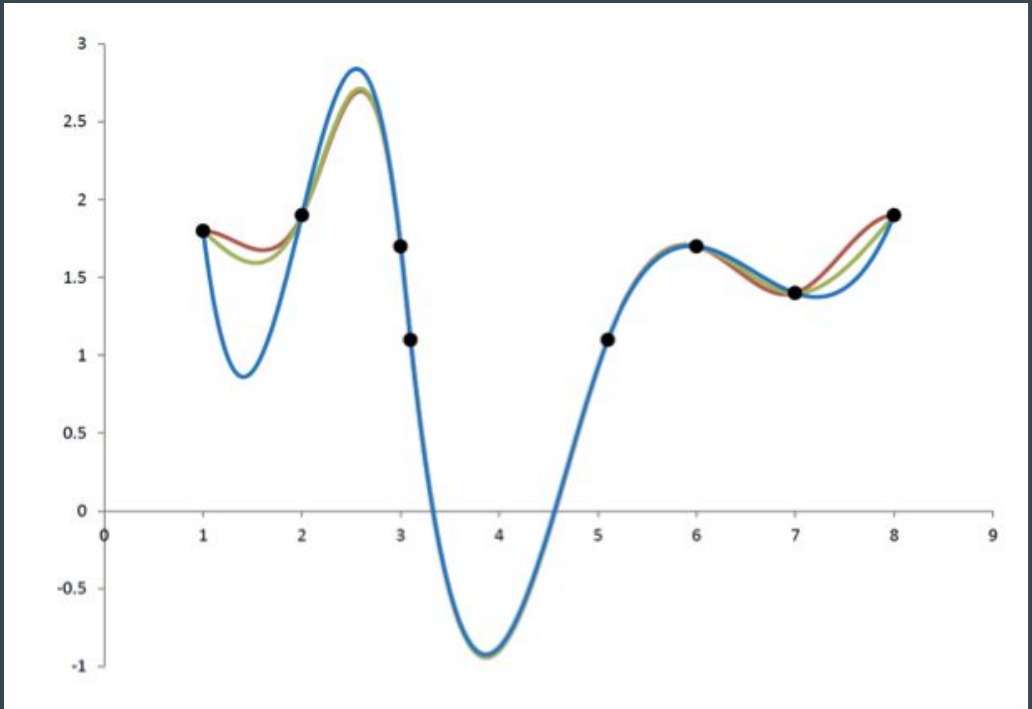
Resampling: Zero Order Hold



Resampling: Linear Interpolation



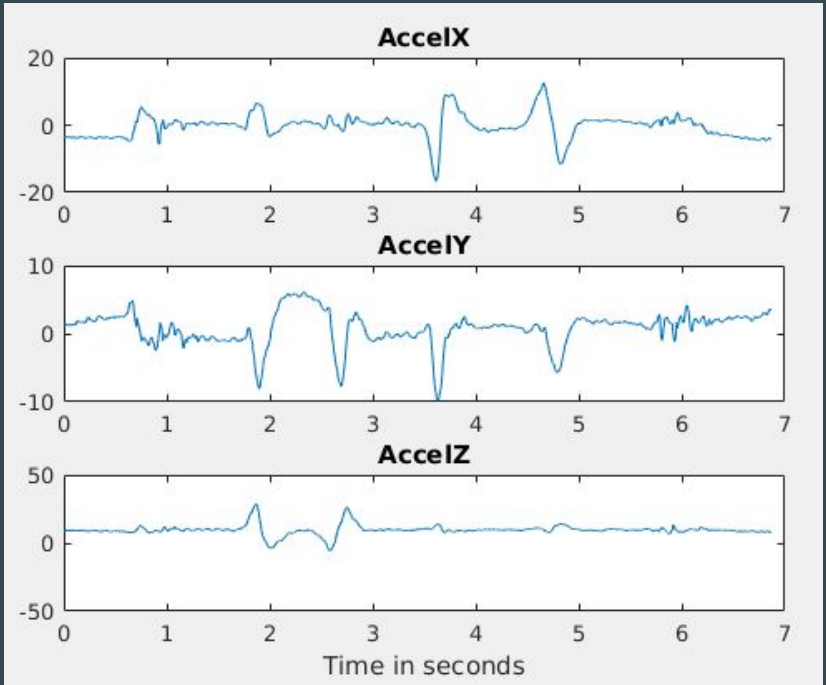
Resampling: Polynomial

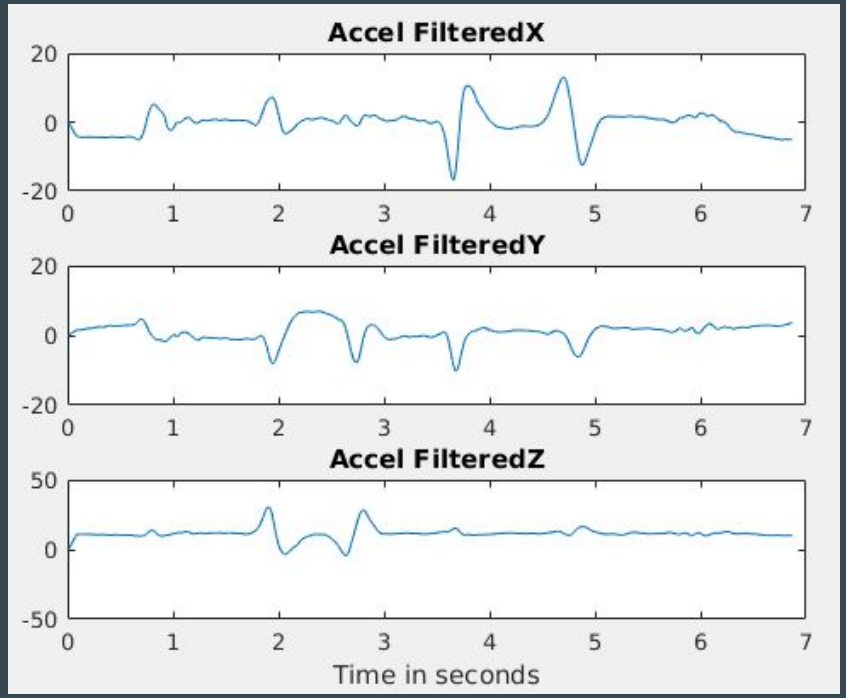


Group Algorithm:

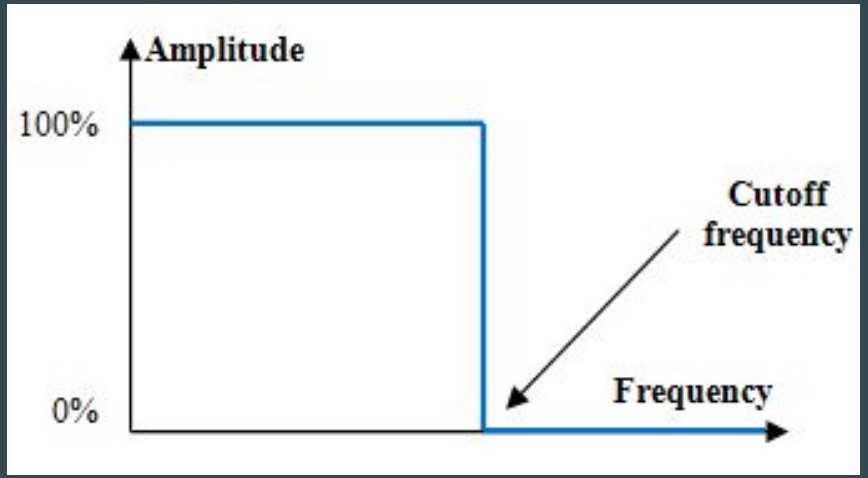
How would you write a zero order hold resampler for streaming data?

Filtering (or in this case, noise removal)

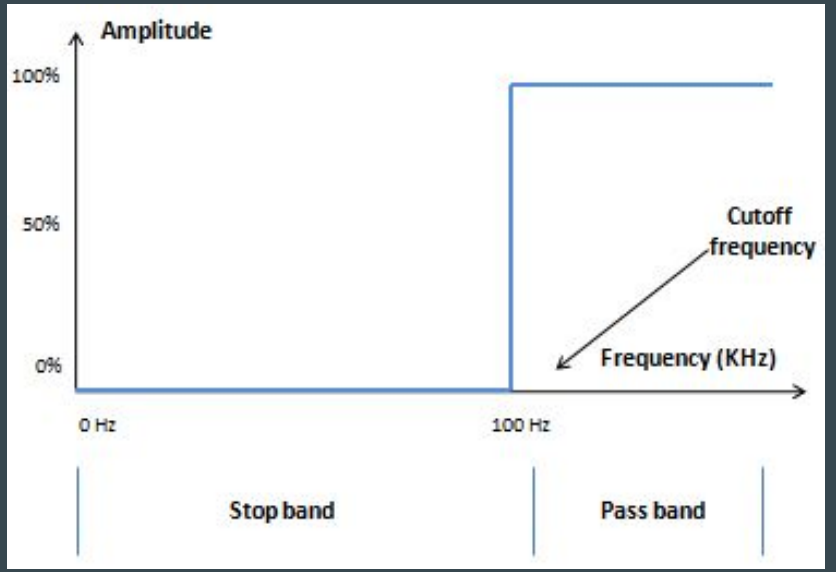




Filtering - Low Pass vs High Pass vs All Pass

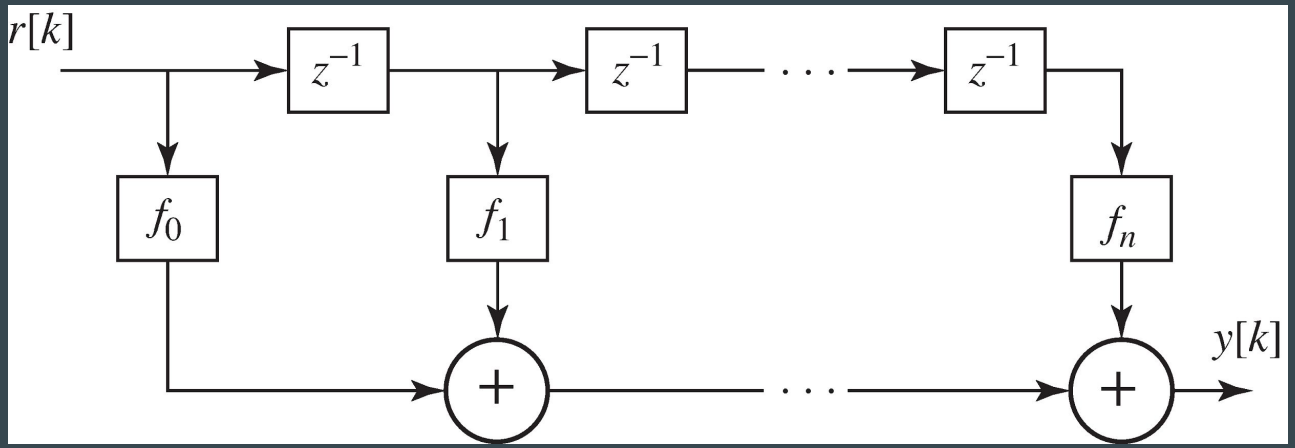


Low Pass



High Pass

FIR Filters - Tapped Delay Line



Group Algorithm:
Write a 4-tap FIR Filter for streaming data

Filter Design

- firpm()? fir1()? fir2()?
- IIR?
- Bandwidth?
- Cutoff frequency?
- Transition band?
- Lions?
- Tigers?
- Bears?

MATLAB TIME
(or Python time)

Figure out a filter that works well for you. Try different bandwidths, lengths, methods, etc.

Gesture Recognition?

Group Algorithm:
How would you do this with thresholding?

Now, put it all together!

Fill in the //TODO flags in VirtualDrumKitTemplate