iPhone Specialist Lab
L07: Touches, Gestures

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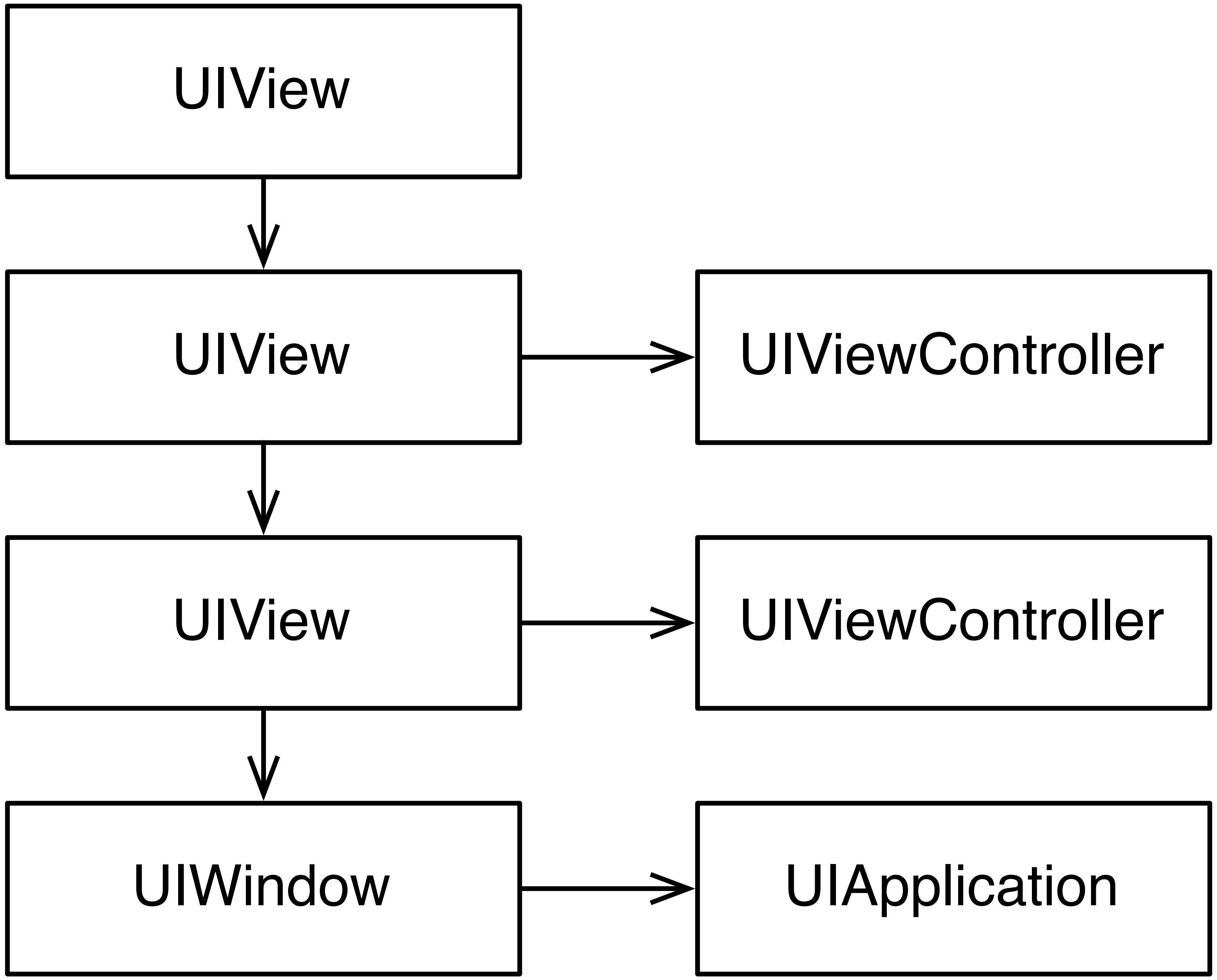
http://hci.rwth-aachen.de/iphone

Touch

Event Handling



Handling Touch Events

Either in UIView or UIViewController

```
// initial touch
- (void)touchesBegan:(NSSet *)touches withEvent:(UIEvent *)event

// updated touch
- (void)touchesMoved:(NSSet *)touches withEvent:(UIEvent *)event

// cancelled touch (by external event)
- (void)touchesCancelled:(NSSet *)touches withEvent:(UIEvent *)event

// finished touch
- (void)touchesEnded:(NSSet *)touches withEvent:(UIEvent *)event
```

UITouch

- Represents single touch
- Location can be reported for a given view
- Previous location included
- Additional properties:
  - tapCount
  - timestamp
  - phase
- Attached gesture recognizers

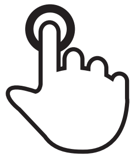
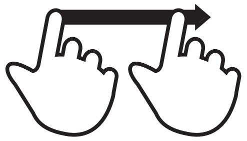
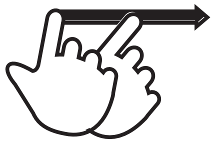
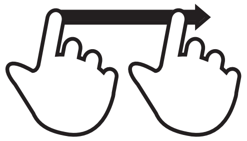
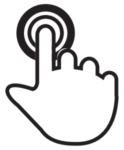
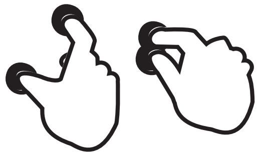
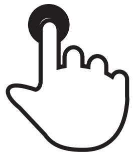
UIEvent

- Stores touches
    - by view and window
    - for gesture recognizers
- Additional properties:
    - timestamp
    - type: touches, motion, or remote controler
    - subtype: event description for non-touch events

Demo: TouchViz

Touch Gestures

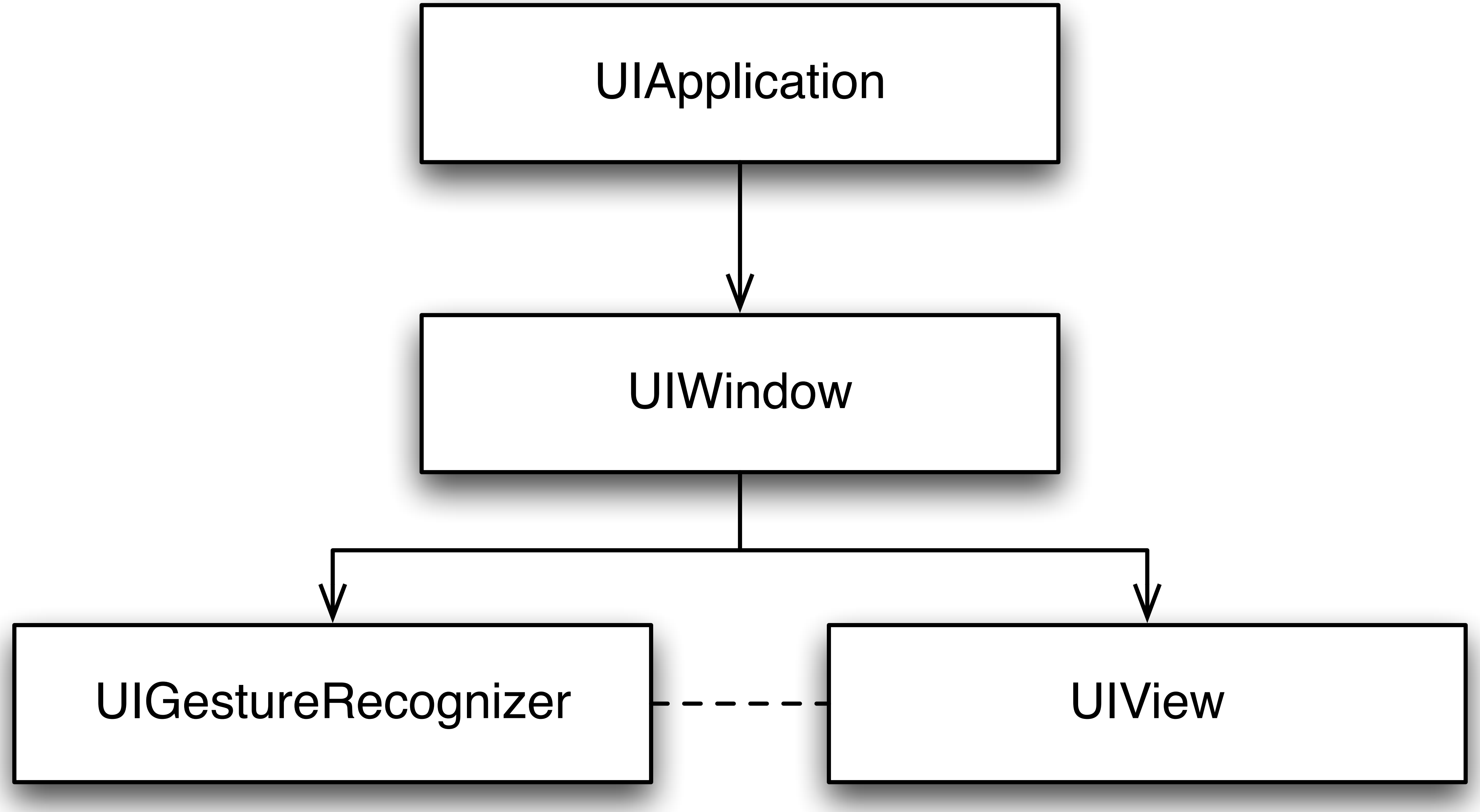
Standard Gestures

	Tap	To press or select a control or item (analogous to a single mouse click).
	Drag	To scroll or pan.
	Flick	To scroll or pan quickly.
	Swipe	In a table-view row, to reveal the Delete button.
	Double tap	To zoom in and center a block of content or an image. To zoom out (if already zoomed in).
	Pinch open	To zoom in.
	Pinch close	To zoom out.
	Touch and hold	In editable text, to display a magnified view for cursor positioning.

Common Gestures

- Tap: press and release one or multiple fingers
- Pinch: move two fingers towards or away from each other
- Rotation: move two fingers around a center
- Swipe: move one or multiple fingers quickly
- Pan: move one or multiple fingers inside a view
- Long Press: hold the finger down steadily

Gesture Recognizers



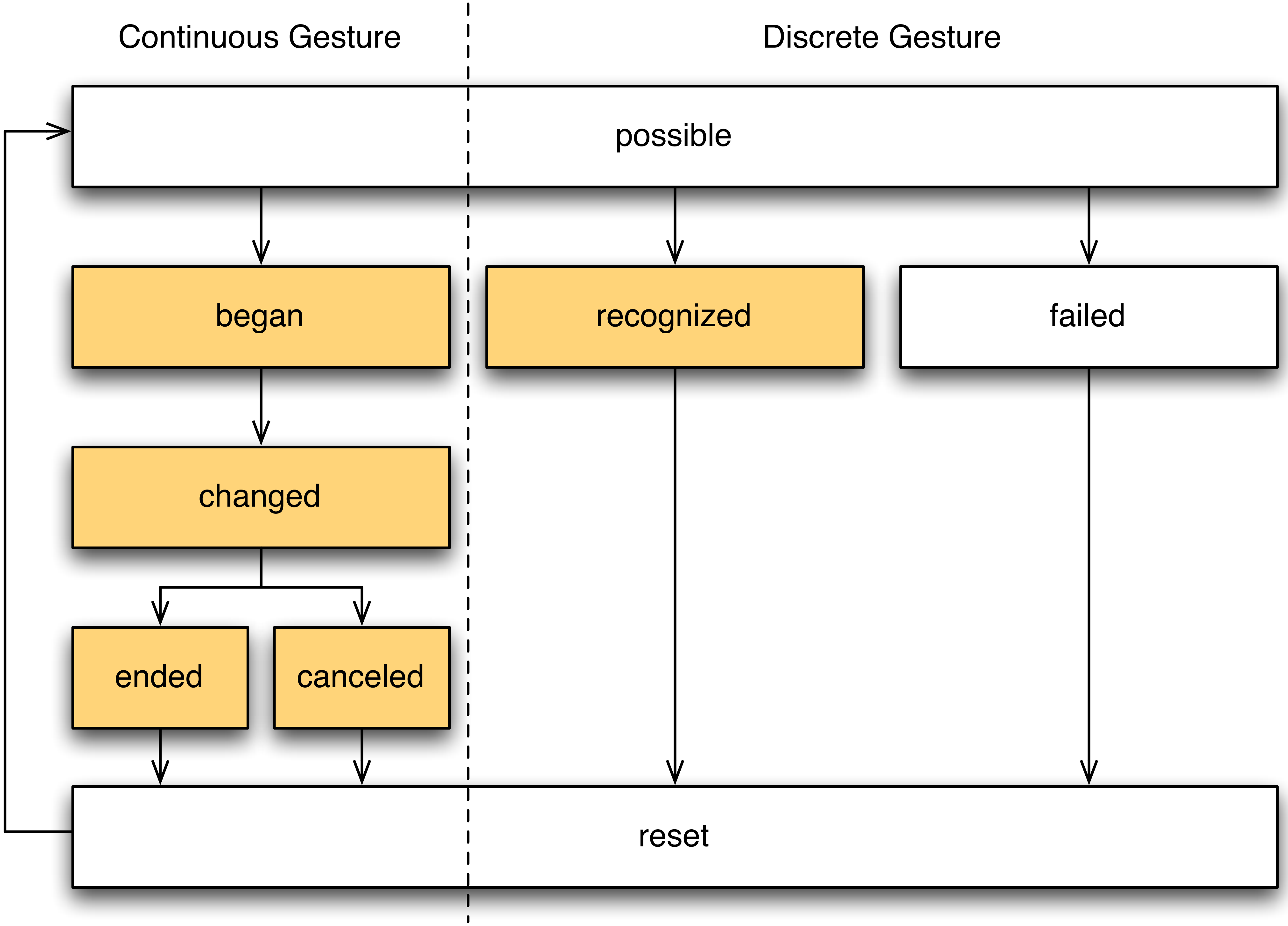
UIApplication

UIWindow

UIGestureRecognizer

UIView

Gesture Recognizer State



UIGestureRecognizer

- Initialize with target and action
- Configure recognizer
  - number of tabs
  - how are touches handled by the view?
  - custom configuration depending on recognizer
- Add gesture recognizer to view
- Delegate used to fine-tune behavior
  - does not receive gesture notifications!

Custom Gesture Recognizers

- React to touch events
  - touchesBegan:withEvent:
  - touchesMoved:withEvent:
  - touchesEnded:withEvent:
  - touchesCancelled:withEvent:
- Reset internal state
  - reset
- Avoid Conflicting Gestures
  - canBePreventedByGestureRecognizer:
  - canPreventGestureRecognizer:

Demo: GestureRecognizer

Core Motion

Accelerometer vs. Gyroscope

- Accelerometer
  - Measures proper acceleration
  - relative to free fall
  - 1.0 = 1G (earth’s acceleration)
- Gyroscope
  - Measure rotation

Core Motion

- Obtain motion data from available sensors
  - Accelerometer (alternative to UIAccelerometer)
  - Gyroscope
- Framework
  - CMMotionManager
  - CMAccelerometerData
  - CMGyroData
  - CMDeviceMotion

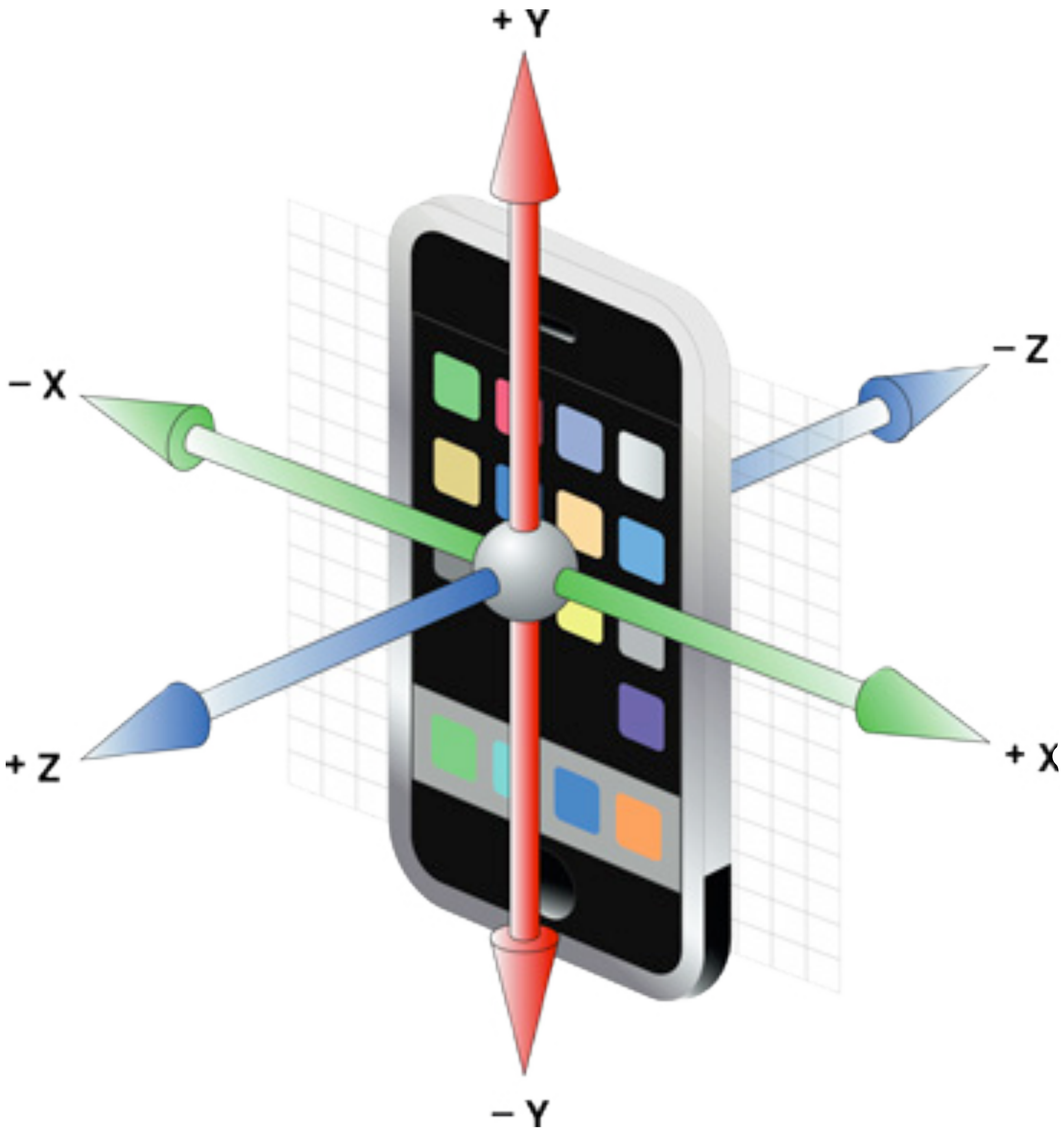
CMMotionManager

- Operates on Accelerometer, Gyro, or both
- Updating with handler:
  - startXUpdatesToQueue:withHandler:
  - block is added to NSOperationQueue
- Updating without handler:
  - startXUpdates
  - query sensor data when needed (e.g., through timer)

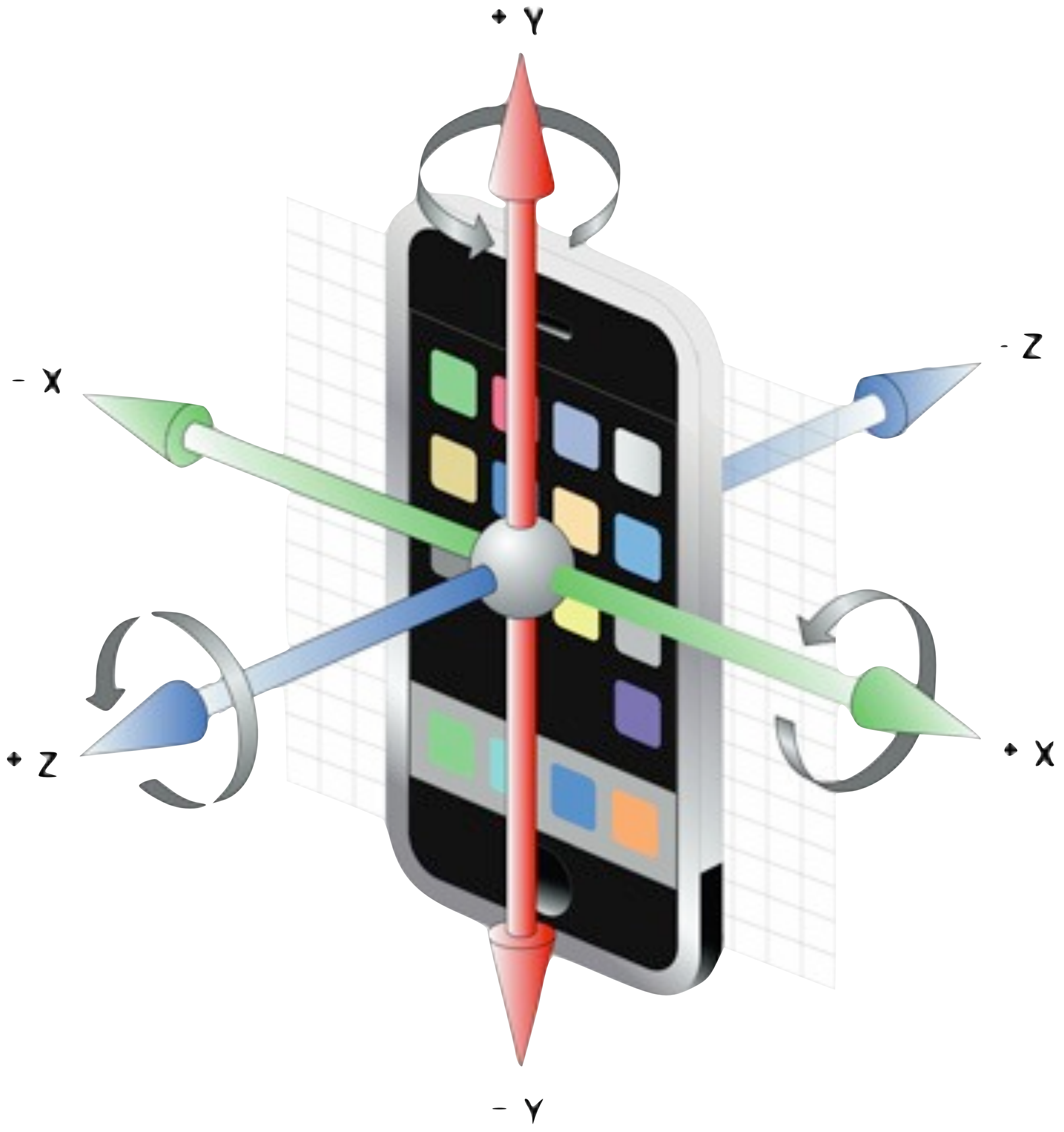
Accelerometer Update Frequency

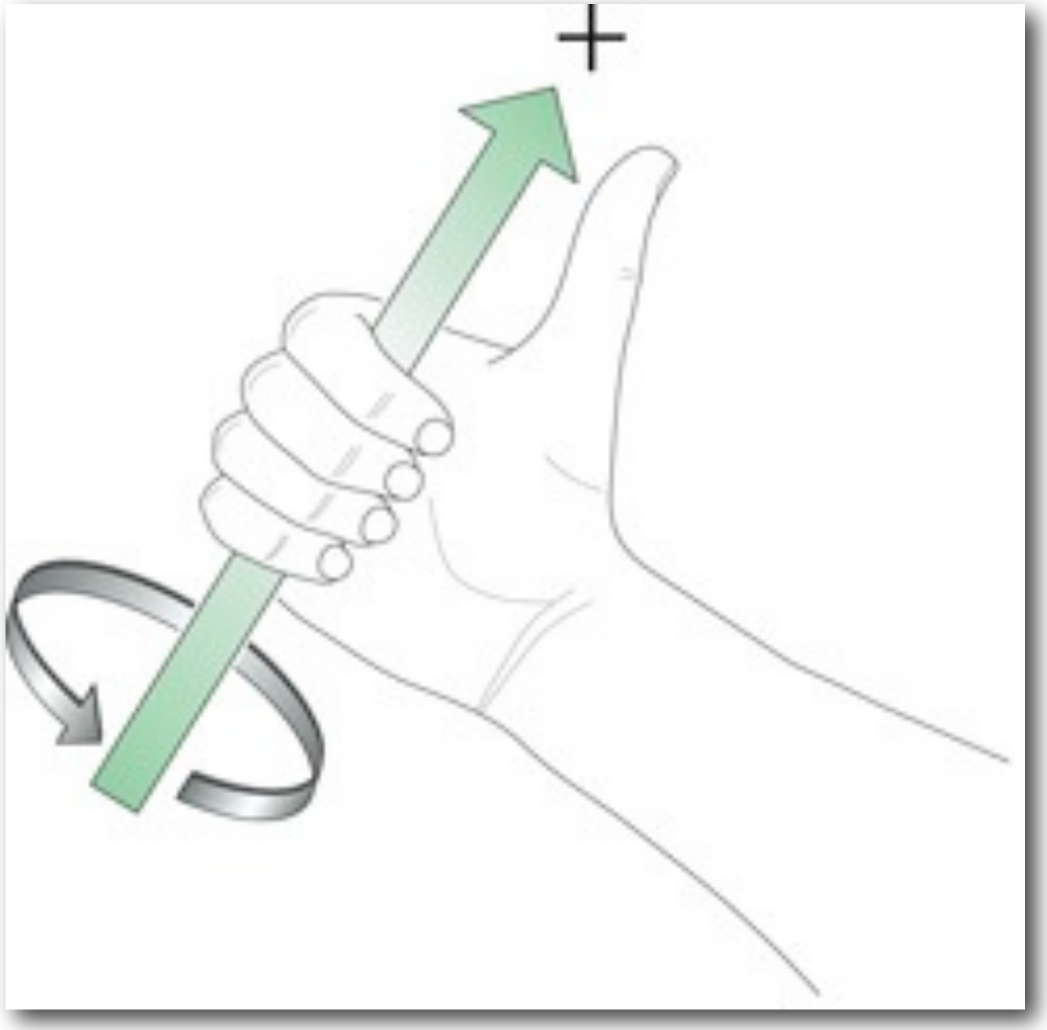
10–20	Orientation detection
30–60	Real-time input (e.g., games)
70–100	high-frequency motion (e.g., hitting or shaking the device quickly)

CMAcceleration



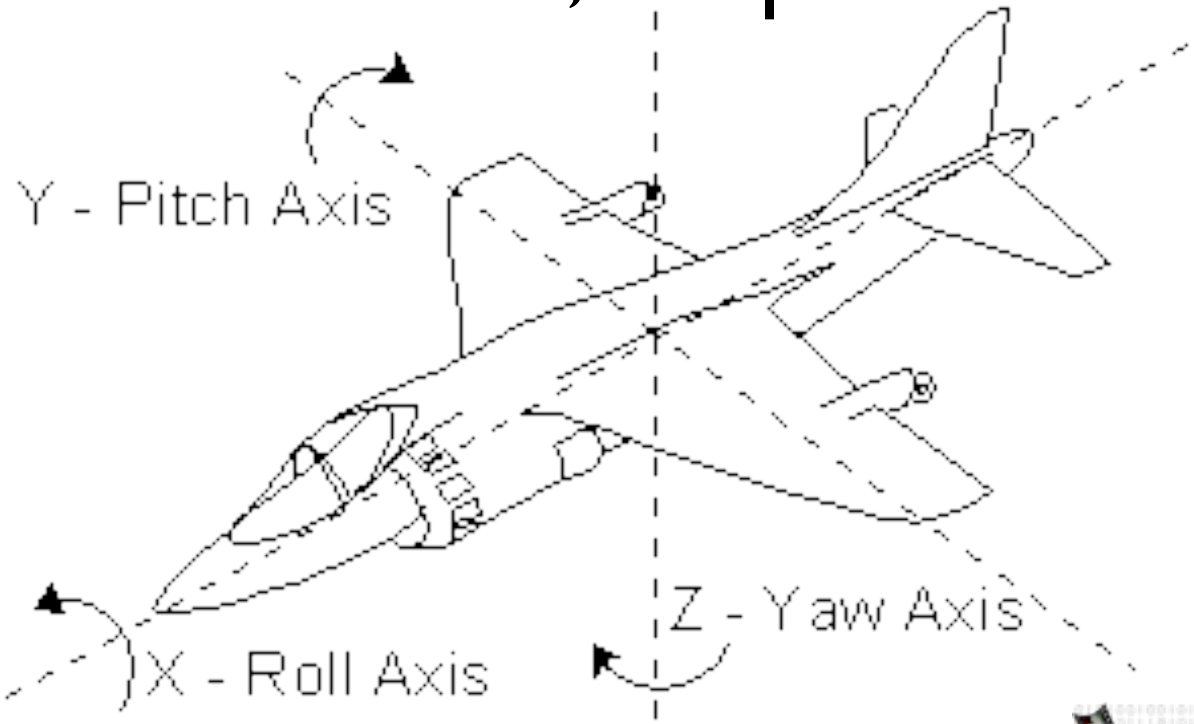
CMGyroData





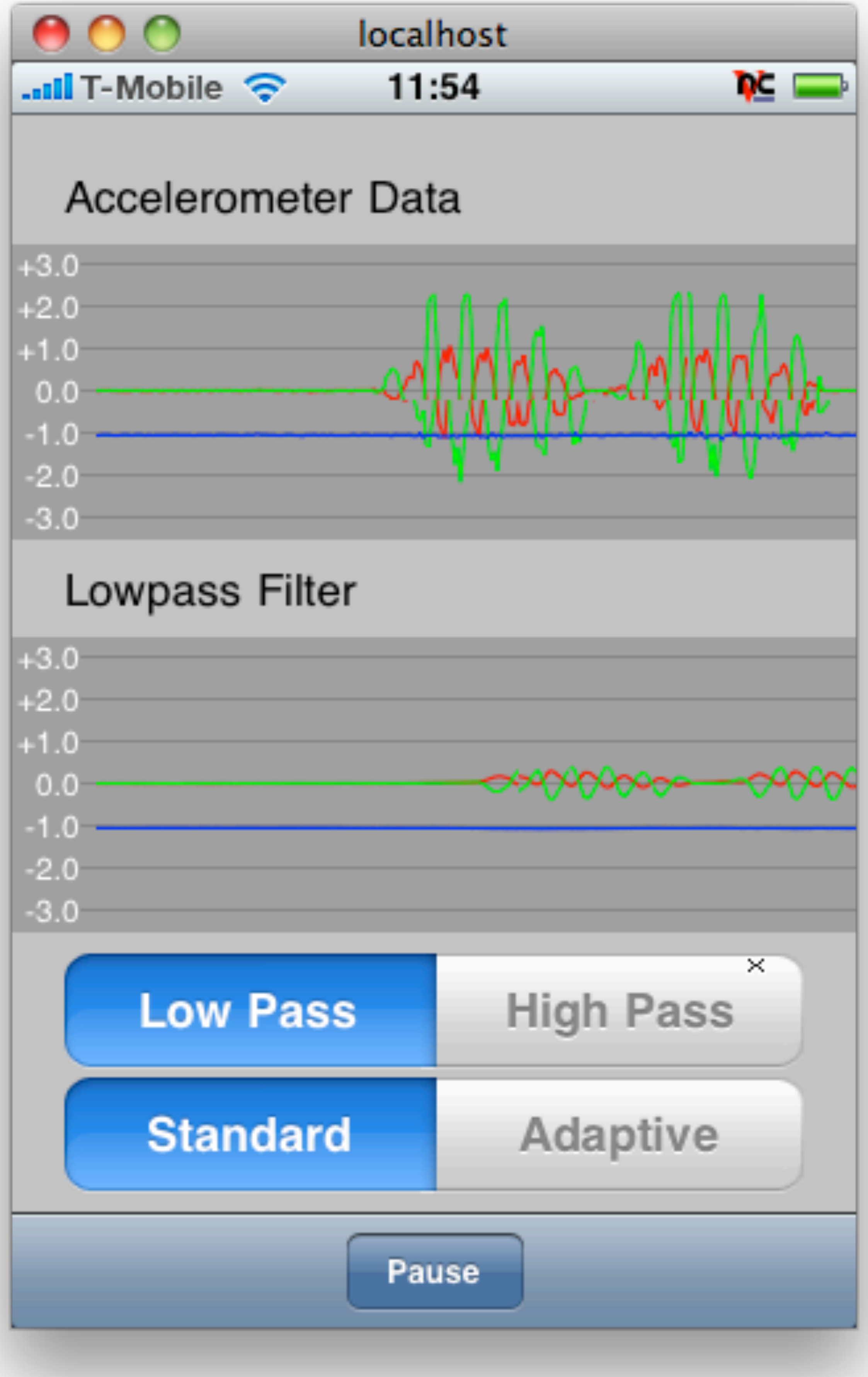
CMDeviceMotion

- Only available with Gyroscope
- Position in 3D Space
  - attitude: roll, pitch, yaw, or rotationMatrix, or quaternion
  - x, y, z rotation
- Acceleration
  - gravity vector
  - user acceleration vector



Filtering Data

- Low-pass filter
  - pass low-frequency, cut off high-frequency signals
  - detect orientation changes
  - reduces jittering
- High-pass filter
  - pass high-frequency, cut off low-frequency signals
  - detect jittering
  - returns relative value

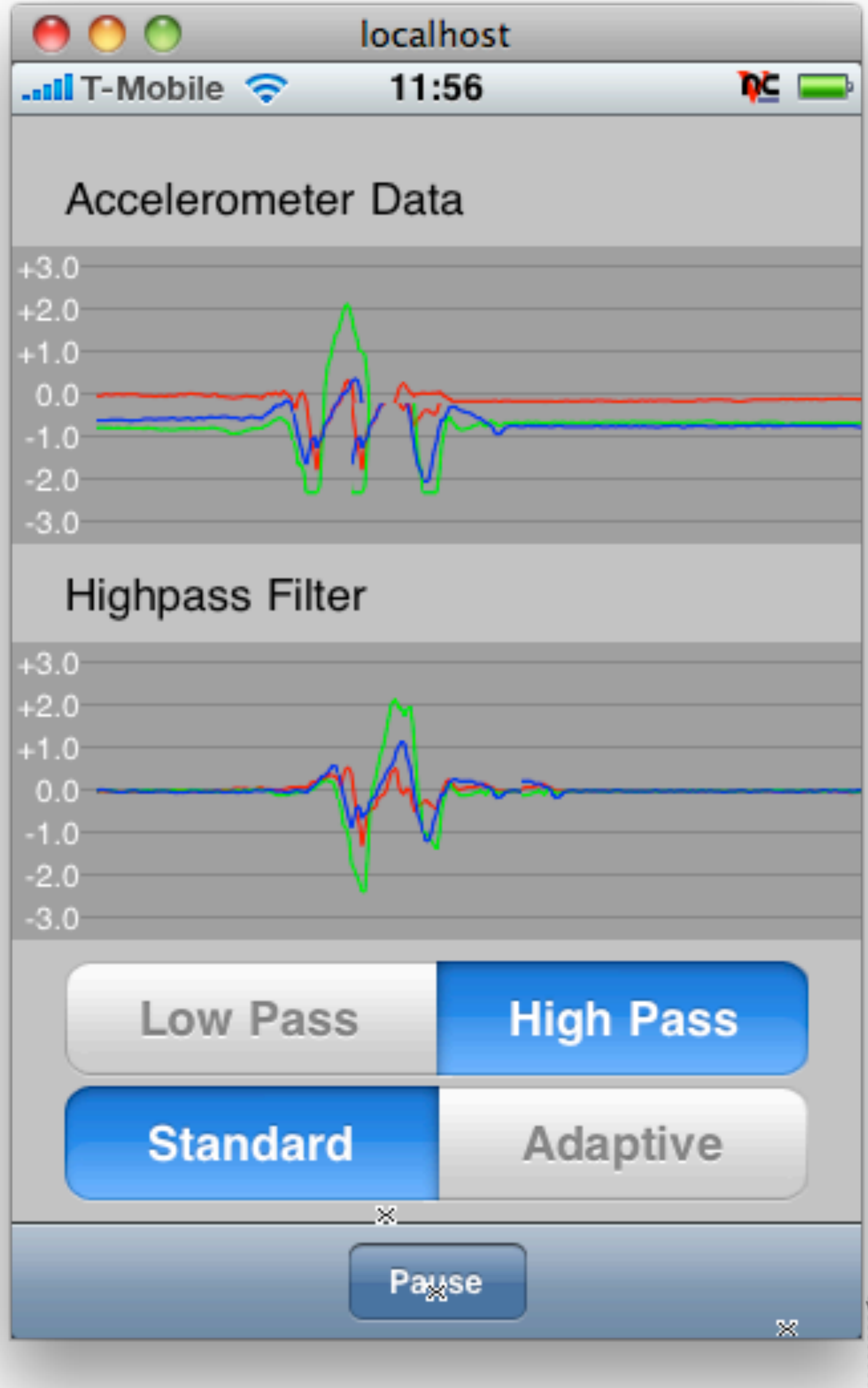


Accelerometer Data

Lowpass Filter

● Low Pass ○ High Pass

● Standard ○ Adaptive



Accelerometer Data

Highpass Filter

○ Low Pass ● High Pass

● Standard ○ Adaptive

Low-Pass / High-Pass Filter

```
  // low-pass filter
CGFloat lowpassFilter(CGFloat value, CGFloat filterFactor) {
  static CGFloat lowpassValue;
  lowpassValue = value*filterFactor + lowpassValue*
    (1.0 - filterFactor);
  return lowpassValue;
}

// high-pass filter
CGFloat highpassFilter(CGFloat value, CGFloat filterFactor) {
  static CGFloat prevValue, highpassValue;
  highpassValue = filterFactor * (highpassValue+value-prevValue);
  prevValue = value;
  return highpassValue;
}
```

Demo: Marble