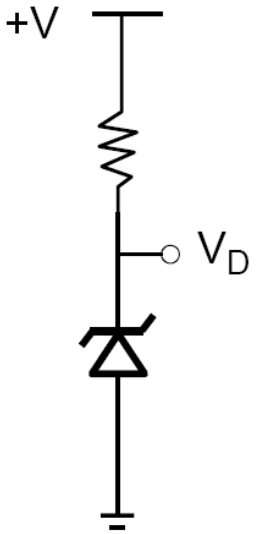
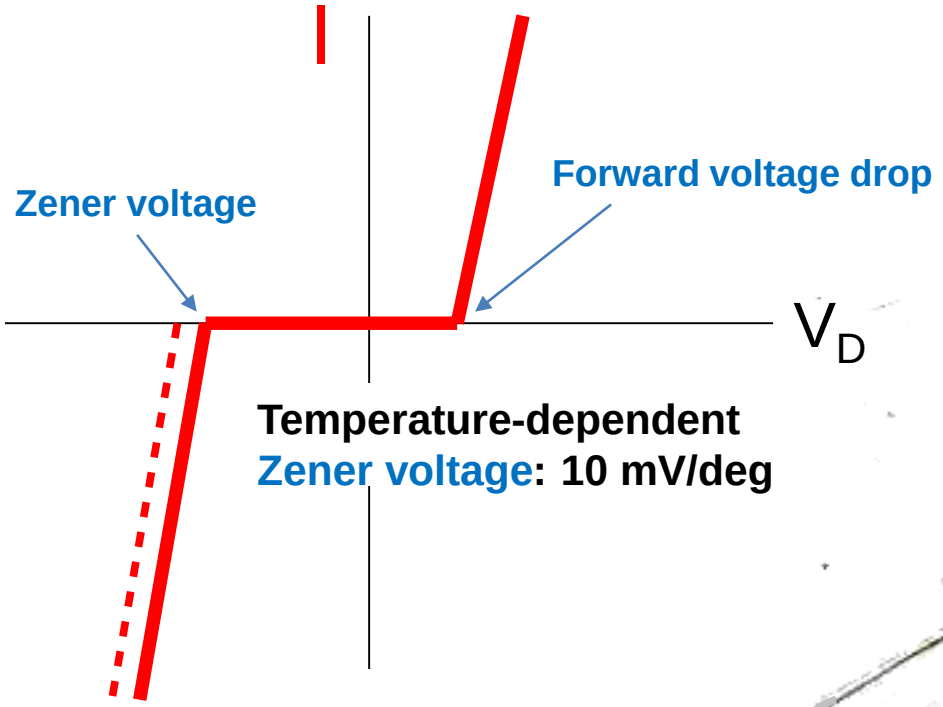
Lab 14: Lock-in Amplification

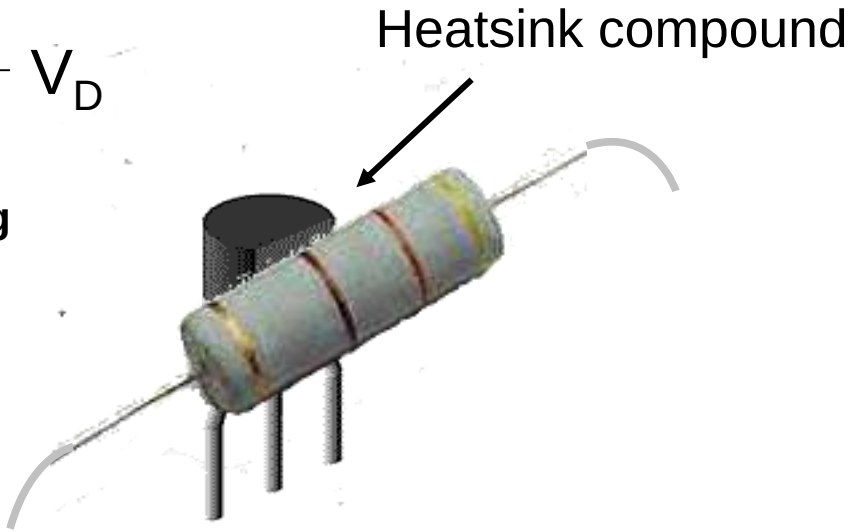
Reminder for this week lab: PI controller with Zener Diode

Temperature Sensor:
Zener diode based IC





Temperature-dependent
Zener voltage: 10 mV/deg



Lab 14: Lock-in Amplification

Allows recovery of signals buried in the noise background

Makes use of both amplitude and phase:
Phase-sensitive detection

Invention generally credited
to Robert Dicke while at MIT

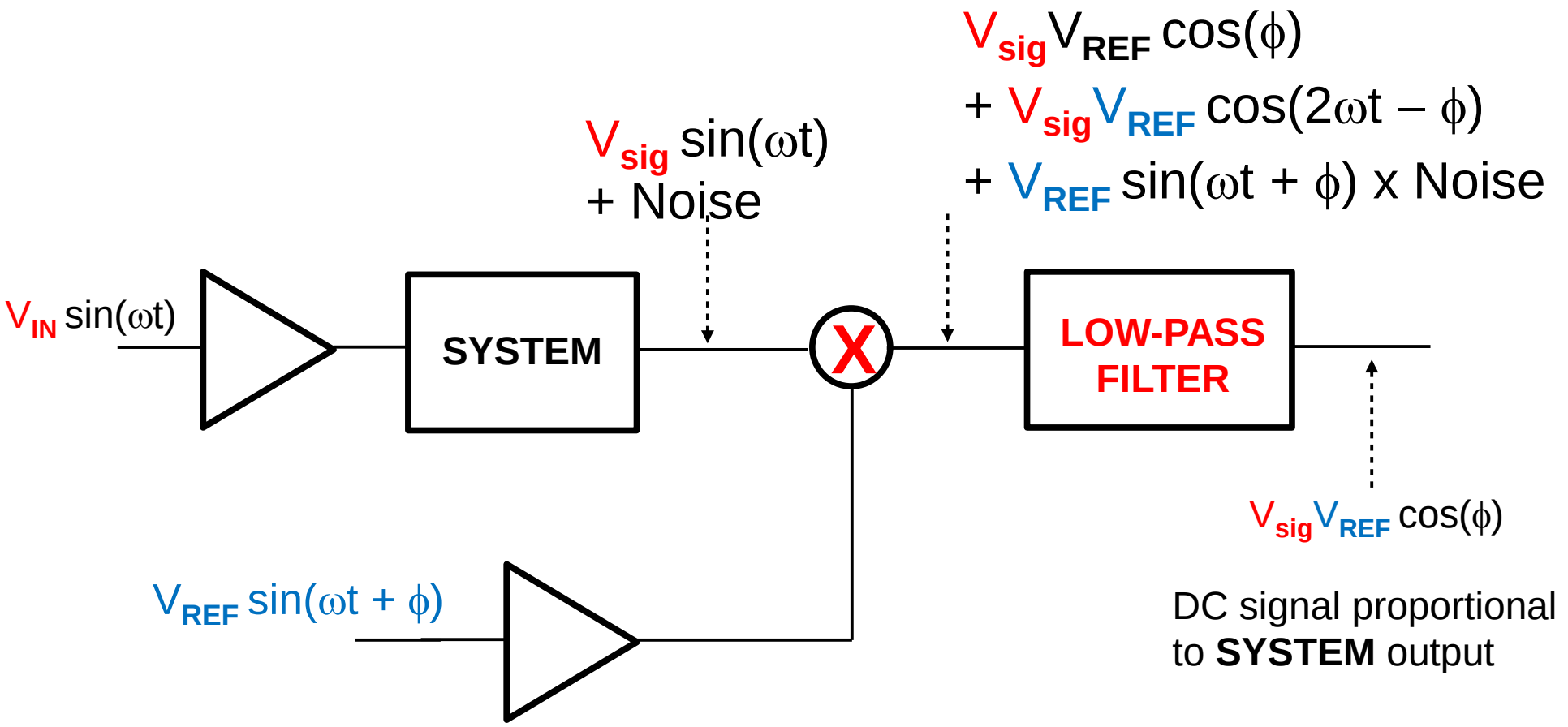
Prof. Robert H. Dicke
Princeton Univ.
(1916—1997)

First commercial lock-in amplifier:
Princeton Applied Research (1962)

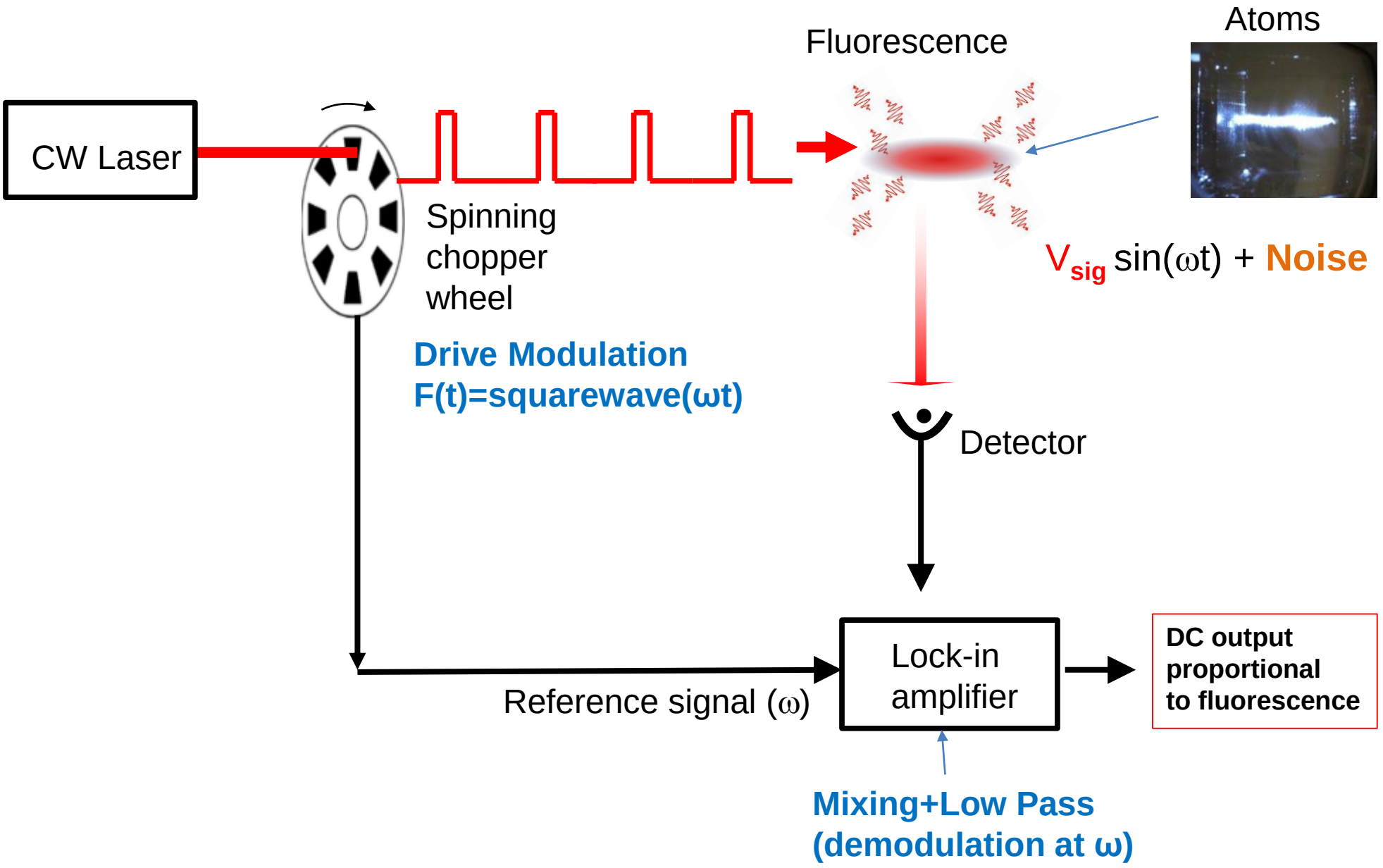
Modern digital signal processing has greatly improved performance

LOOSE ANALOGY: Finding someone in a crowded stadium

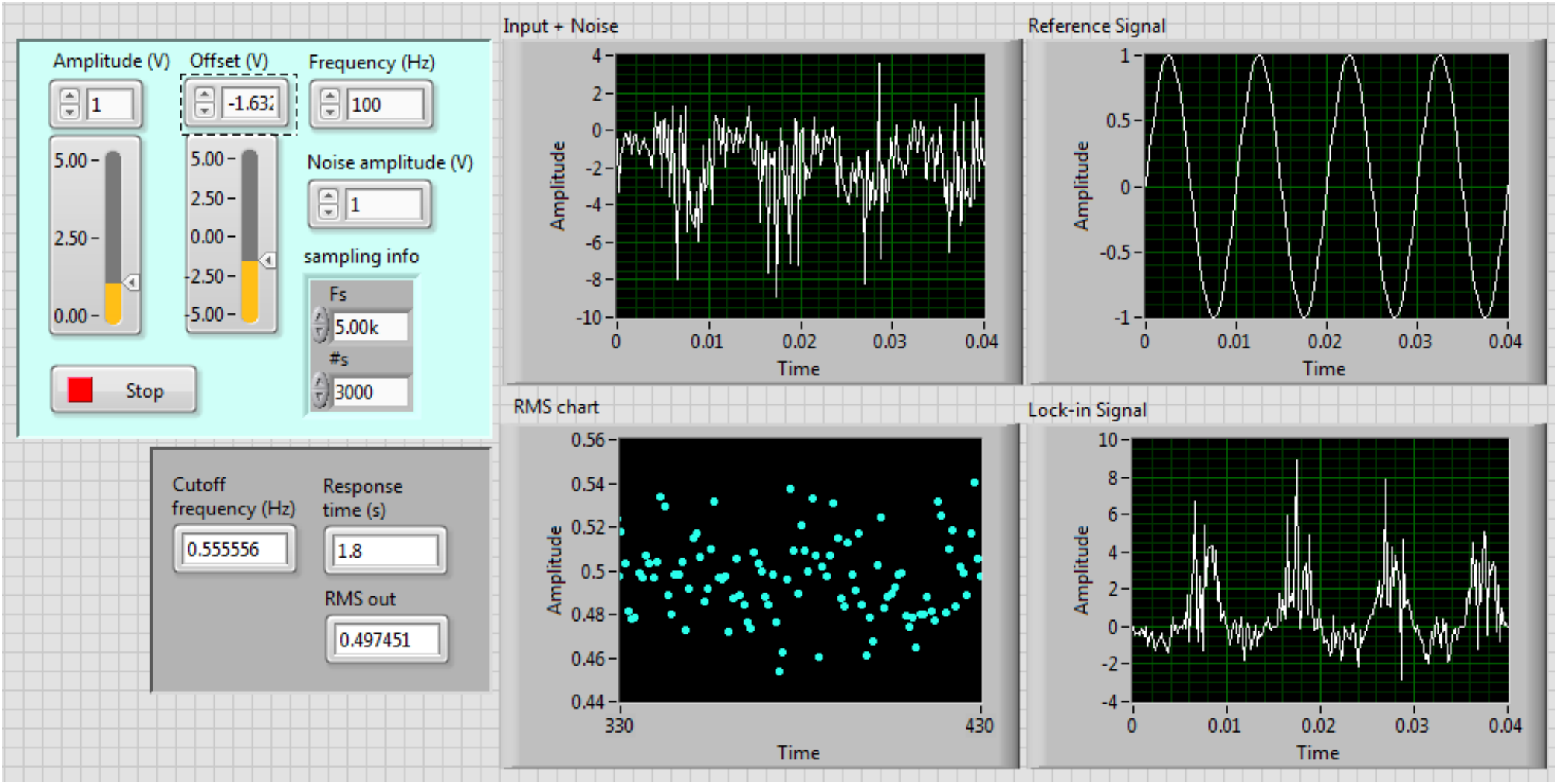
THE CONCEPT


$V_{sig} V_{REF} \cos(\phi)$
$+ V_{sig} V_{REF} \cos(2\omega t - \phi)$
$+ V_{REF} \sin(\omega t + \phi) \times$ Noise
$V_{sig} \sin(\omega t)$
+ Noise
$V_{IN} \sin(\omega t)$
SYSTEM
X
LOW-PASS FILTER
$V_{sig} V_{REF} \cos(\phi)$
$V_{REF} \sin(\omega t + \phi)$
DC signal proportional to **SYSTEM** output

EXAMPLE: LASER SPECTROSCOPY



LabView Lock-in Simulation: Assignment 14



Alternative solution to race conditions in LabView:
FUNCTIONAL GLOBAL VARIABLES

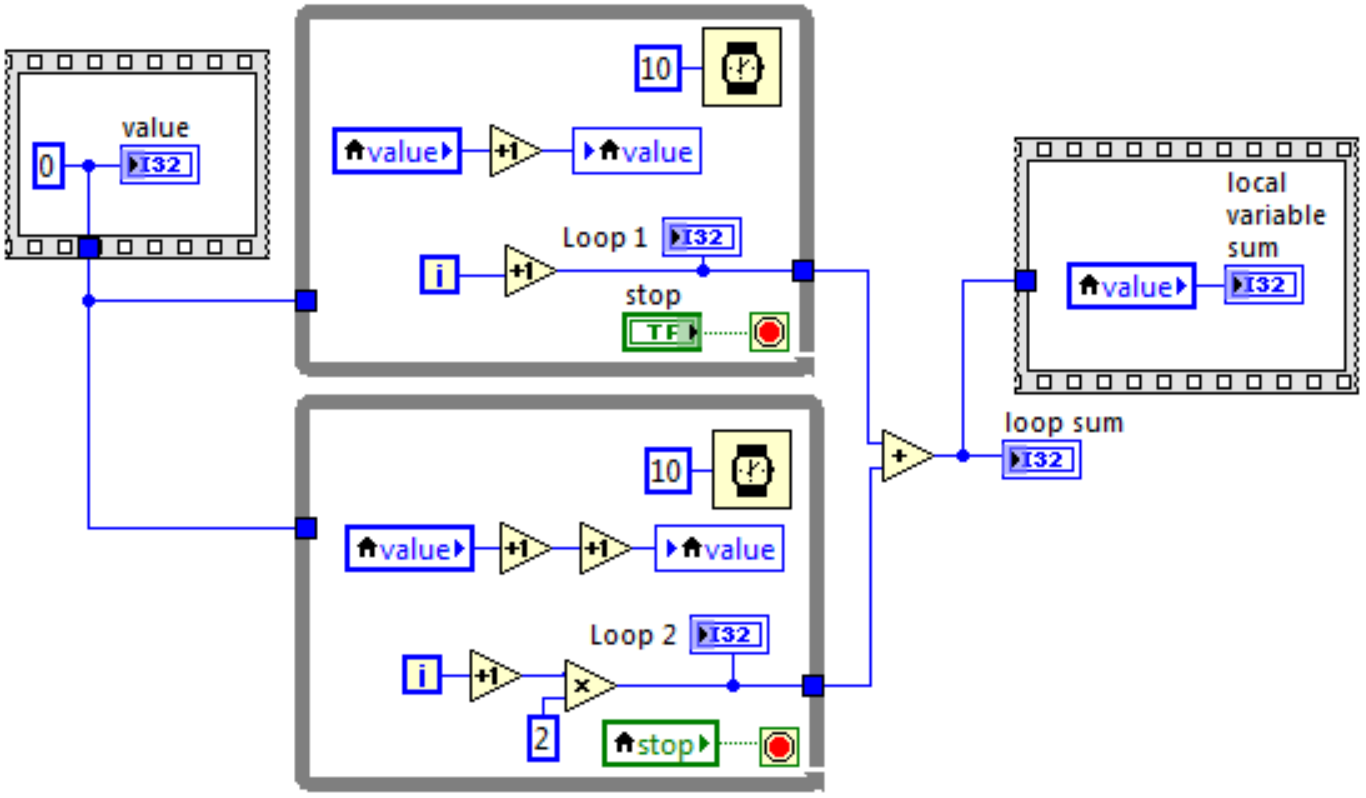
An independent Sub-VI with:

* Control (input) and/or Indicator (output)
* Enum control of case structure (eg. read/write)
* Uninitialized shift-register
* Loop that runs only once

Example: **Race condition in parallel loops**

Read/write may not happen in desired sequence

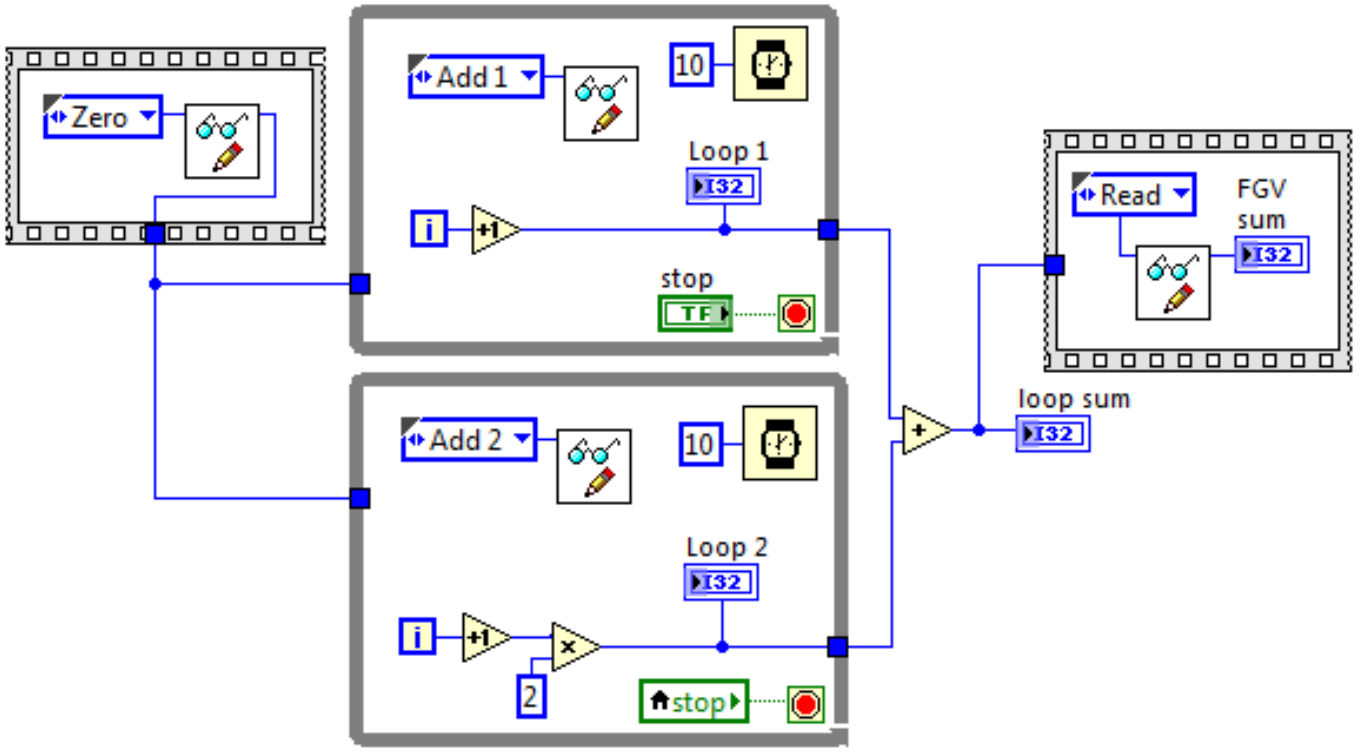
Can write to 'value' variable simultaneously



Functional Global Variable eliminates this race condition

Sub-VI protects variable from being written simultaneously

Replace the read/write local variables with single FGV



Customized Sub-VI serves as **Functional Global Variable**

Enum selects 1 of 4 possible states to determine operation: **0**, **+1**, **+2**, or **Read**

Uninitialized shift register holds the current value for each FGV call

FGV can't be accessed by simultaneous calls