2010 EE PhD Quals: Solutions
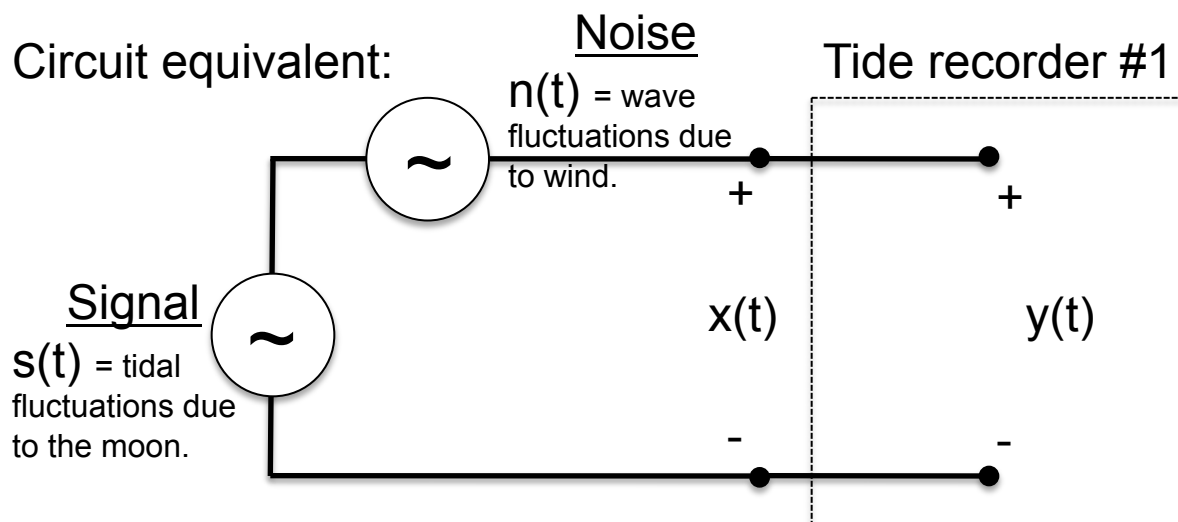
Prof. Daniel Spielman

1. For this system, y(t) = x(t), hence the device is linear and time-invariant. The frequency response is constant for all frequencies.

2. Advantages: inexpensive, easy to build, durable.

   Disadvantages: probably need a boat to actually make the measurements. More importantly, the data will be noisy. The measurements are subject to unwanted variations from surface wave fluctuations. An improved device would filter out this unwanted high frequency noise. Note: tidal fluctuations are on the order of 10^{-5} Hz, while wave action has a dominant component around 10^{-1} Hz.

Circuit equivalent:

Noise

n(t) = wave fluctuations due to wind.

Tide recorder #1

+

x(t)

+

y(t)

Signal

s(t) = tidal fluctuations due to the moon.

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3. There are lots of choices for better measurement systems which can incorporate the desired low-pass filtering. I like the device shown in Question 4.