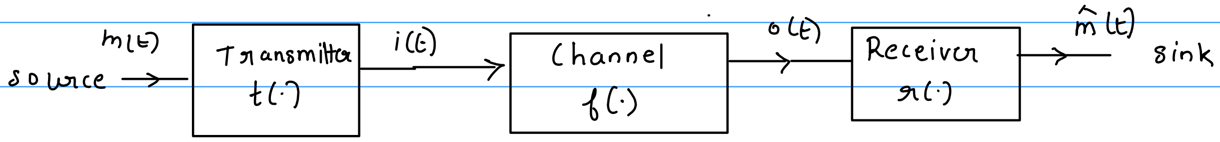
AV314 - Communication Systems I

Lecture 5 31/07/2019

Review

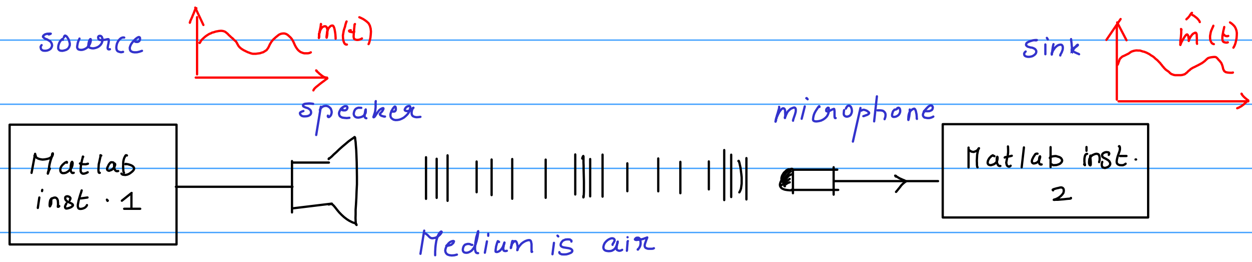


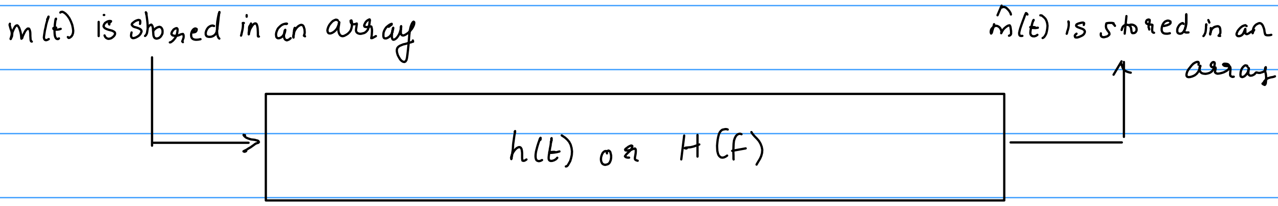
Design $t(\cdot)$ and $r(\cdot)$

such that $e(m(t), \hat{m}(t)) \leq \varepsilon$,

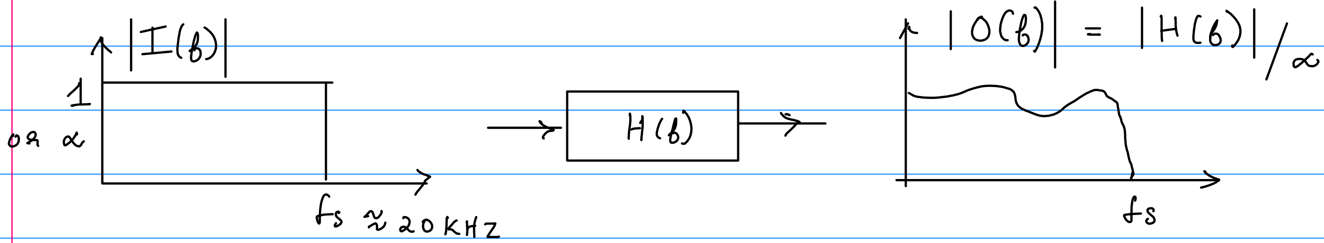
given $f(\cdot)$

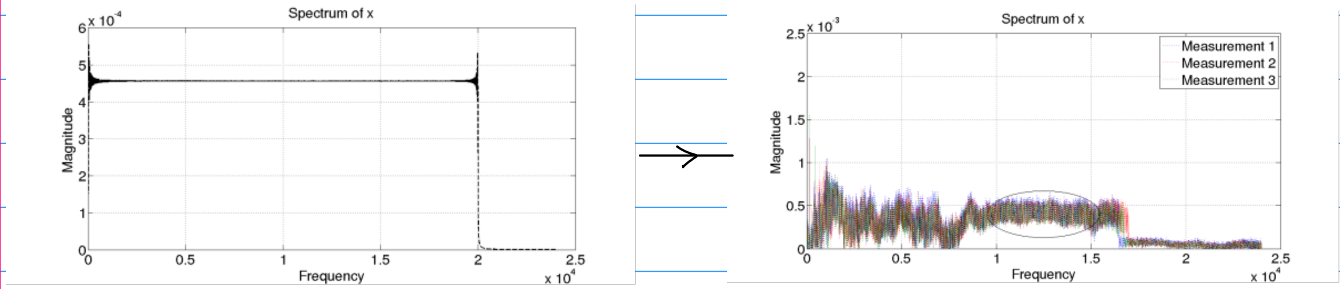
- Let us take an example to understand channel modelling using LTI systems.





everything in between is considered as the channel.

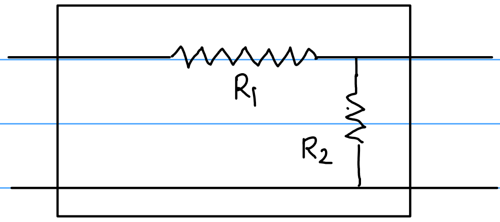




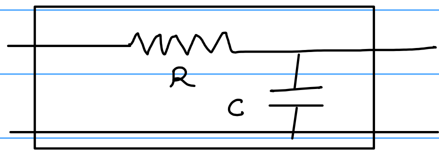
* real-world Channels are <u>well modelled</u> as LTI systems or LTI filters.

e.g. can you model a wire as a LTI filter?

a model



another model

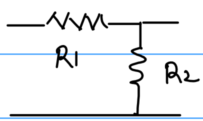


o our revised communication problem is:

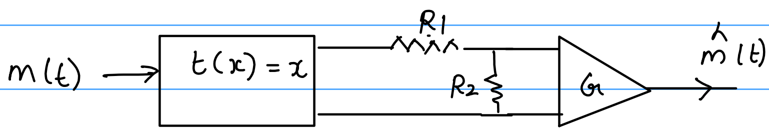
design $t(\cdot)$ and $r(\cdot)$ such that $e(m(t), \hat{m}(t)) \le \varepsilon$

given $h(t)$.

e.g. suppose $h(t)$ is

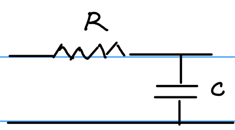


and $m(t)$ is some voltage signal, can you design $t(\cdot)$ and $r(\cdot)$ such that $\hat{m}(t) = m(t)$?



$$G = \frac{R_1 + R_2}{R_2}$$

e.g. suppose $h(t)$ is



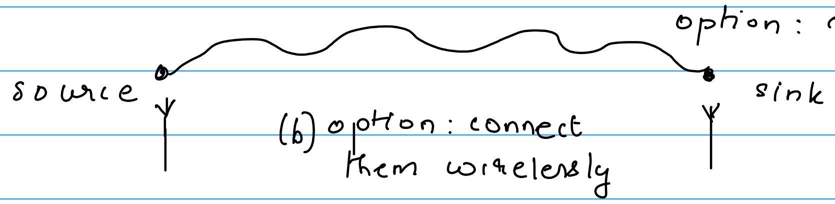
then?

an important idea here is that $t(\cdot)$ and $r(\cdot)$ are used to nullify the effect of the channel (at least in our current understanding).

- On the choice of $h(t)$ or the channel.

In our communication problem, sometimes the engineer has a choice of $h(t)$
The mechanism can be selected by the engineer.

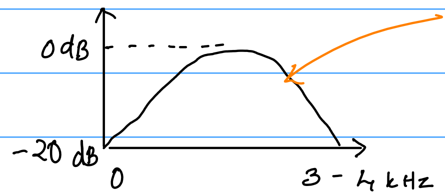
option: connect source and sink by wire?



for each option, we need to get the $h(t)$ and design a $t(\cdot)$ and a $r(\cdot)$ so that the communication problem is solved.

- Characteristics of wired and wireless channels.

Recall the simple model that we had above for a wired channel, it is a filter and it is essentially a low pass filter in nature. It turns out that wired channels can usually be modelled as low pass filters (LPFs) (sometimes they won't pass DC signals). For example, if we look at telephone channels, its $|H(f)|$ has the following characteristic:

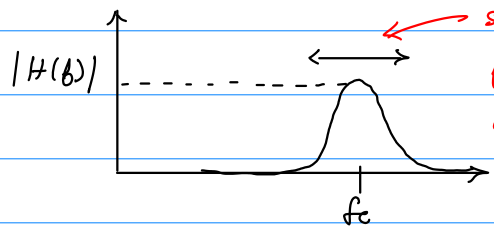


Note that telephone channels are meant for voice signals which are low pass / baseband signals.

So the takeaway point here is that we can think of wired channels as low pass filters.

What about wireless channels?

These are channels in which a "high frequency" (more on this later) propagates from the source to the sink via electromagnetic propagation. If one were to find out the $H(f)$ for such a channel/mechanism, one would observe that



signals which are composed of frequencies in a band around a center freq f_c are transmitted. other frequencies are cut off by the channel.

So <u>wireless channels</u> act like <u>bandpass filters</u>.

What are the wireless channels that are available to us?

Assignment: Spectrum allocation in India.

Important points to take away from this class:

a) Channels can be modelled as LTI filters.

b) There are model fitting procedures to find out LTI filter models ($h(t)$ or $H(f)$) for a channel.

c) The $t(\cdot)$ and $r(\cdot)$ functions are used to nullify the effect of the channel so that $e(m(t), \hat{m}(t)) \leq \varepsilon$.

d) Wired channels are modelled as lowpass filters, wireless channels as bandpass filters.