

Communication aspects of multi-agent unmanned systems

JEFFRY SALAZAR

From Cerritos College
Majoring in Electrical Engineering

Faculty Advisor: Dr. Yasamin Mostofi
Mentor: Saandeep Depatla
Dept. of Electrical & Computer Engineering
Funded by The National Science Foundation



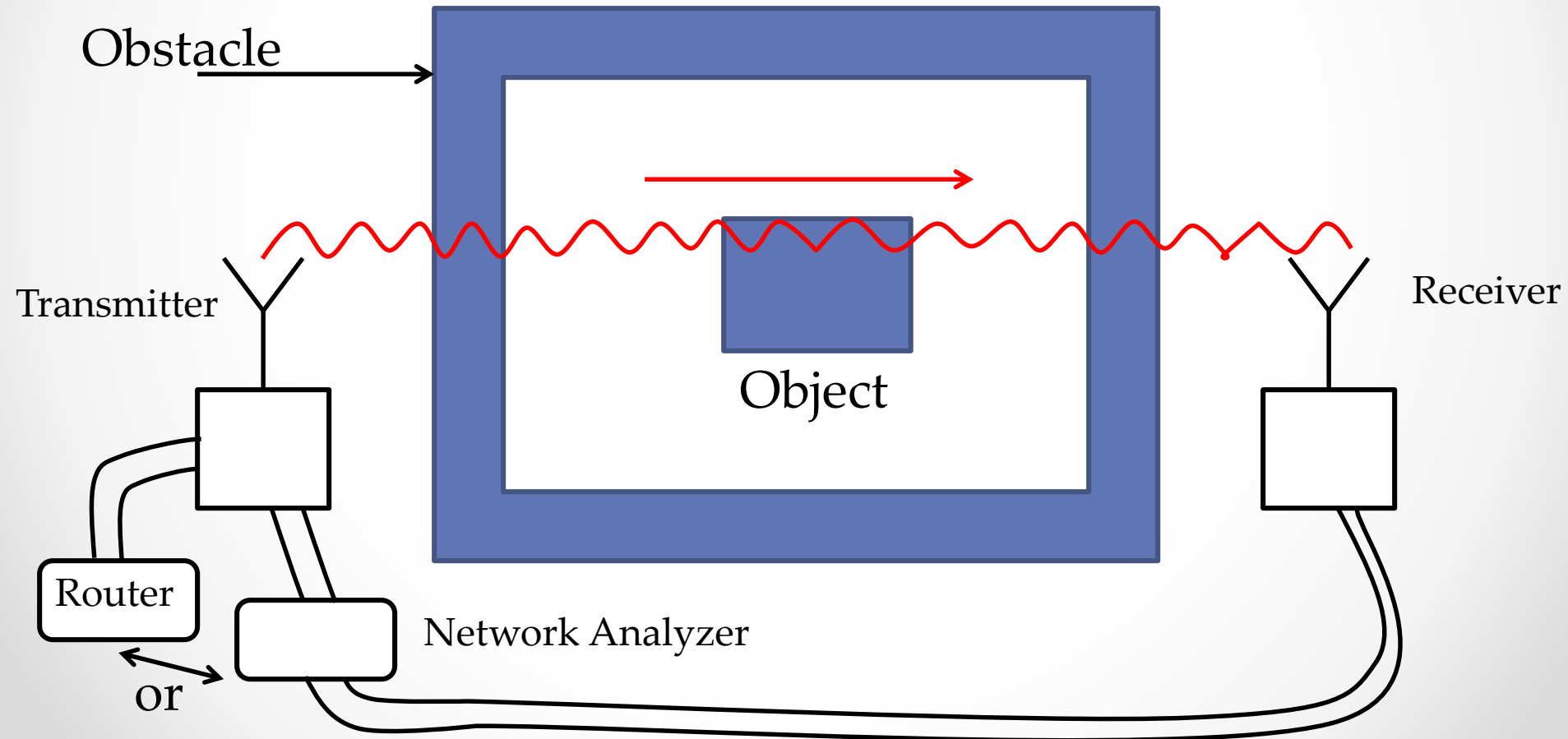
Mostofi's Research Lab

- Using multiple robots to map environment, including hidden obstacles
- Achieved with lasers and wireless networks

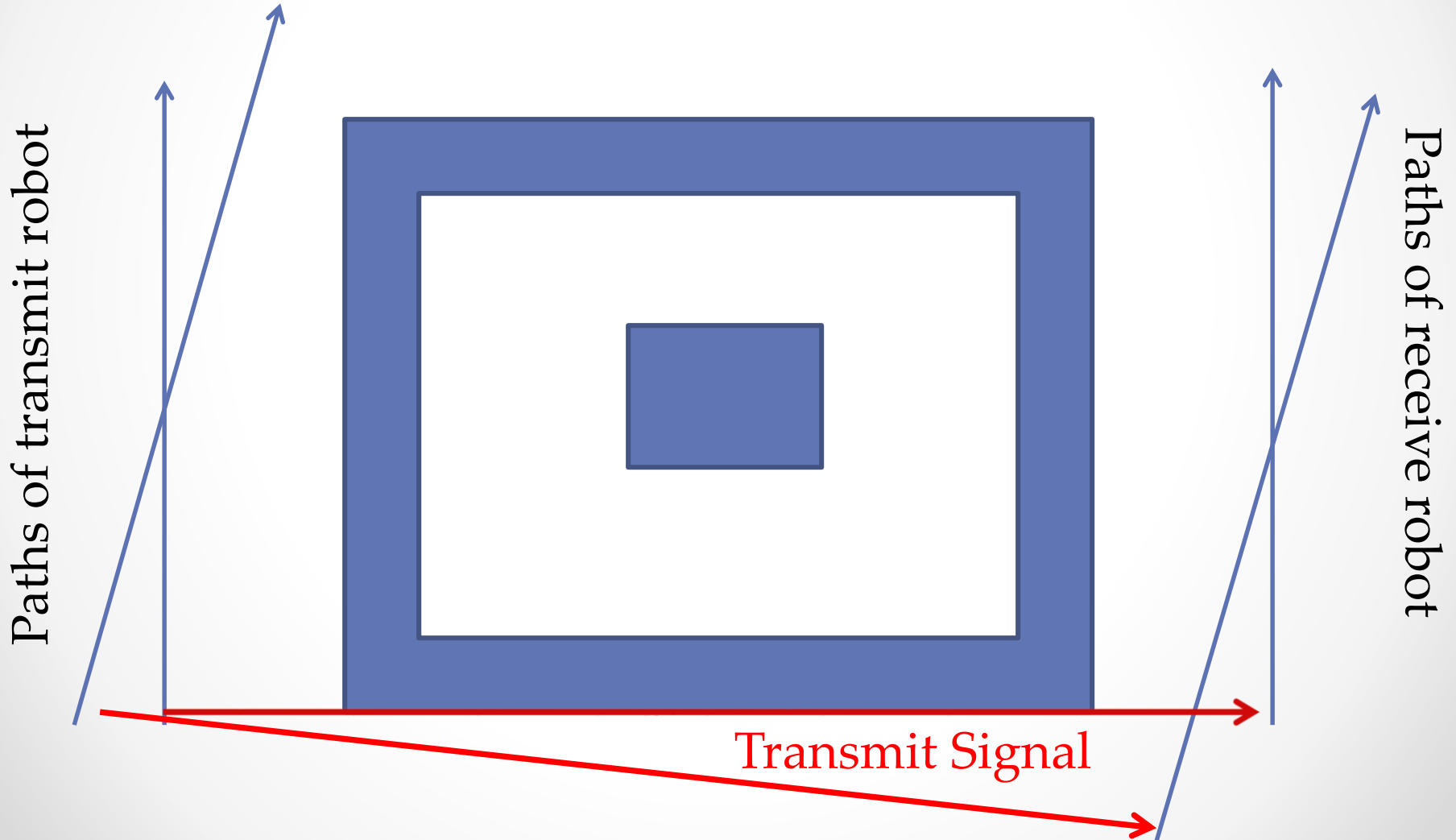


Experiment

Measuring the drop in signal strength



Path during experiment



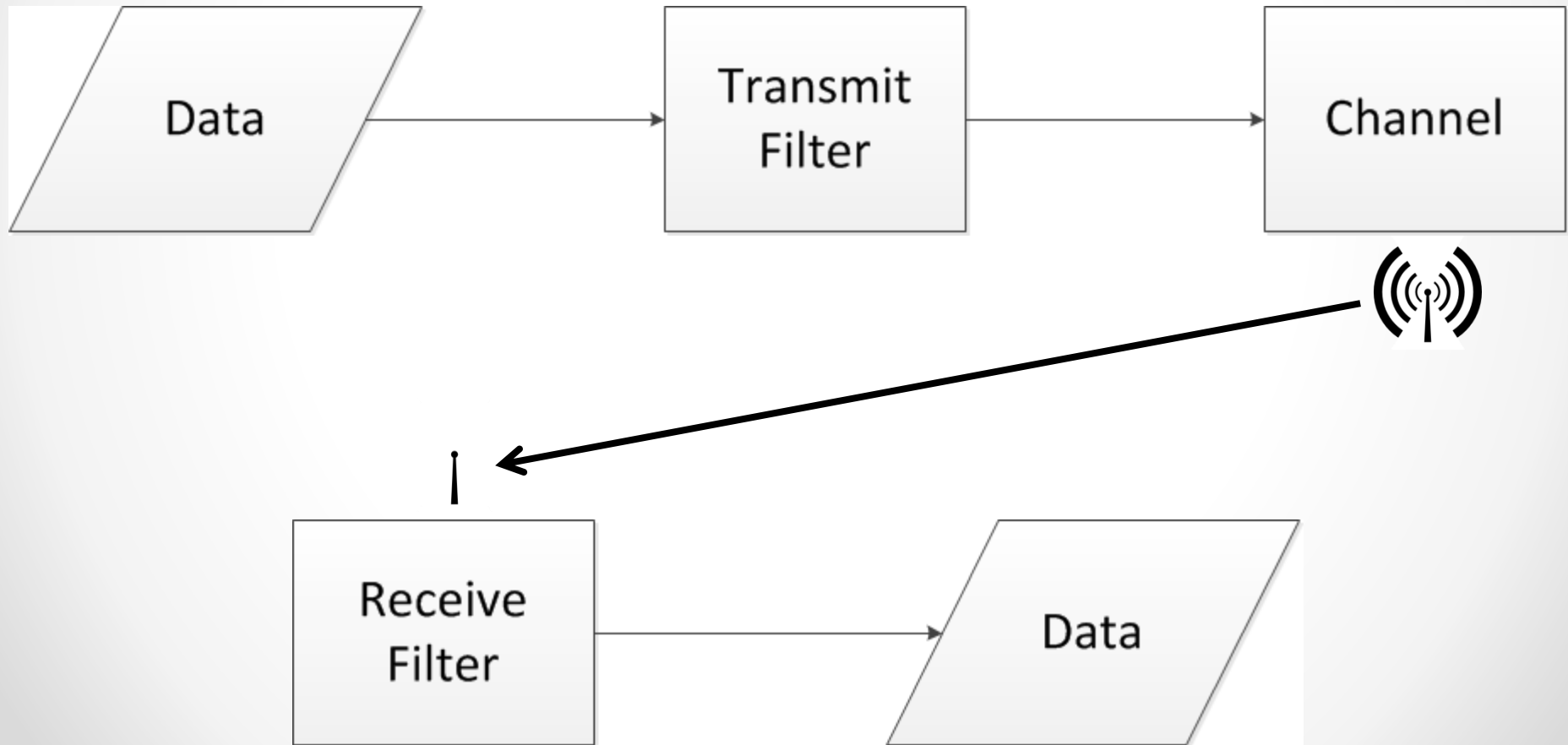
Mostofi's Research Lab

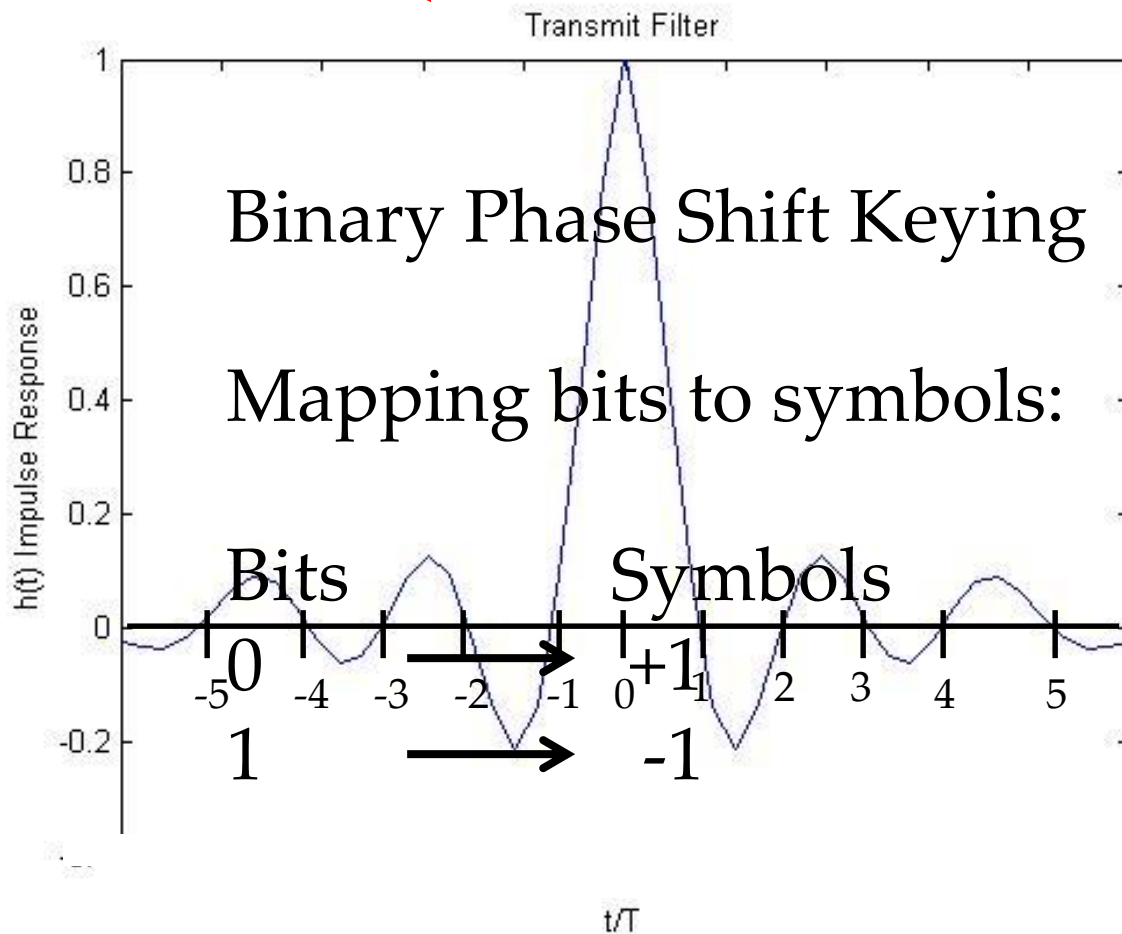
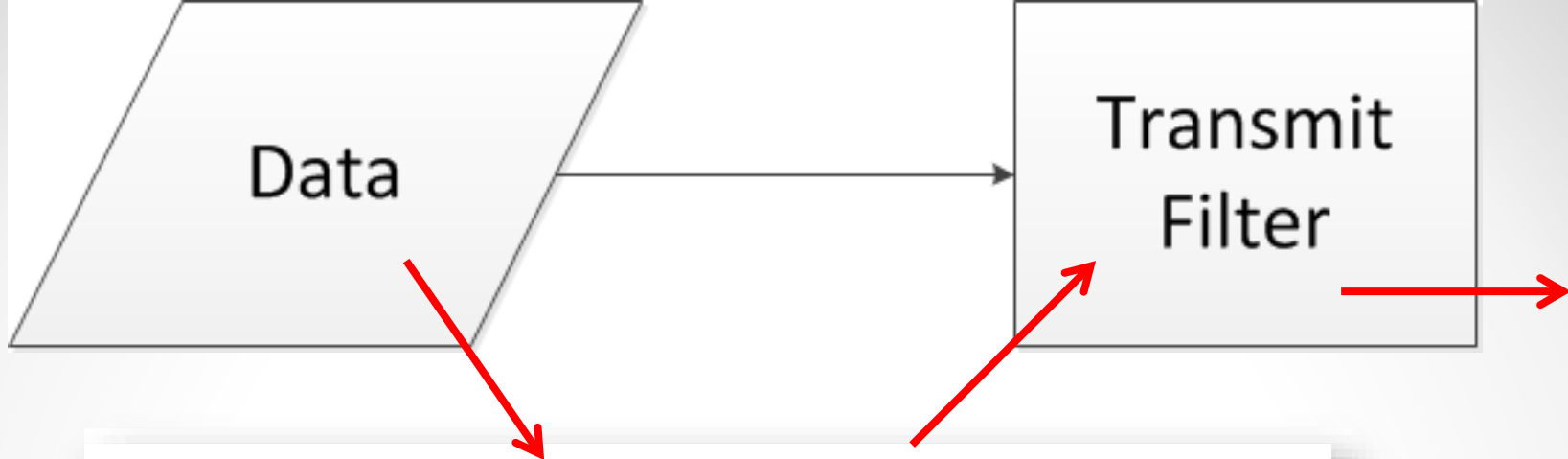
- These capabilities can be used for:
 - Emergency Response
 - Surveillance and Security
 - Defense
 - Intelligent homes and factories
 - Environmental Monitoring

Goals

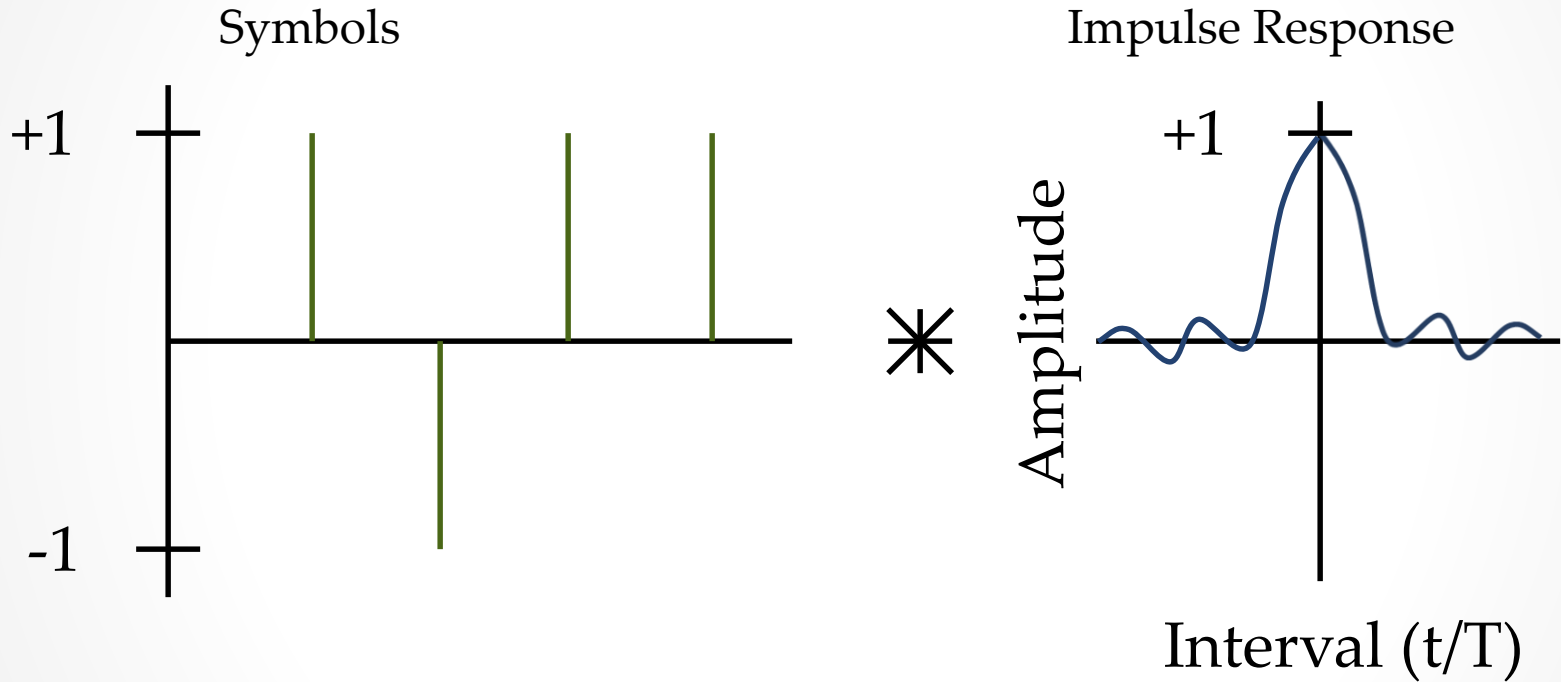
- Simulating communication transceivers
- Effects of channel
 - Noise
 - Multipath
- Design a replica of mounting fixture of antenna

Simulation of Signal Transmission

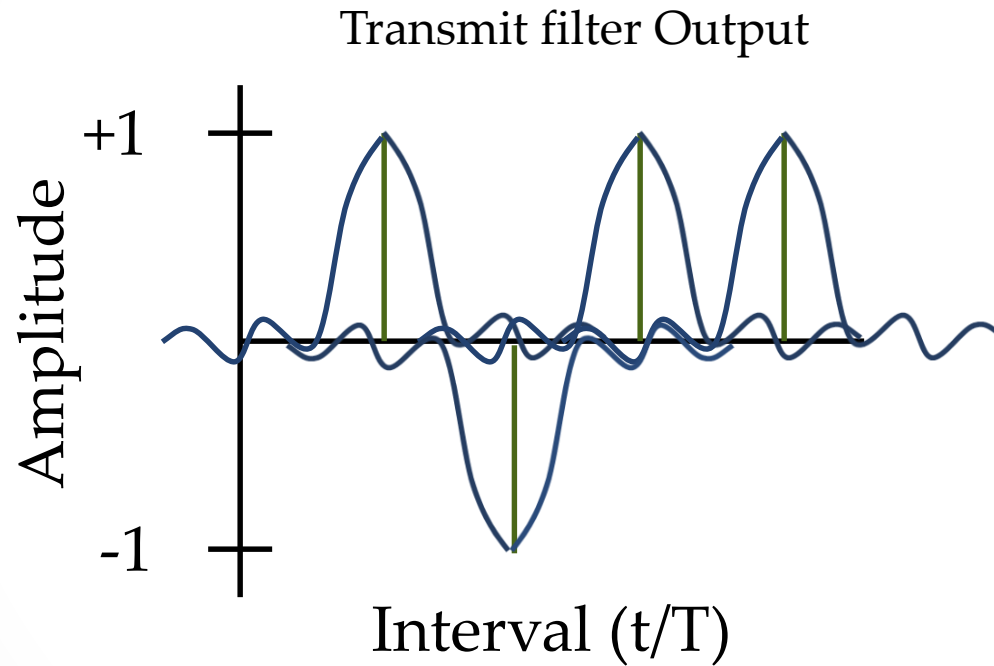


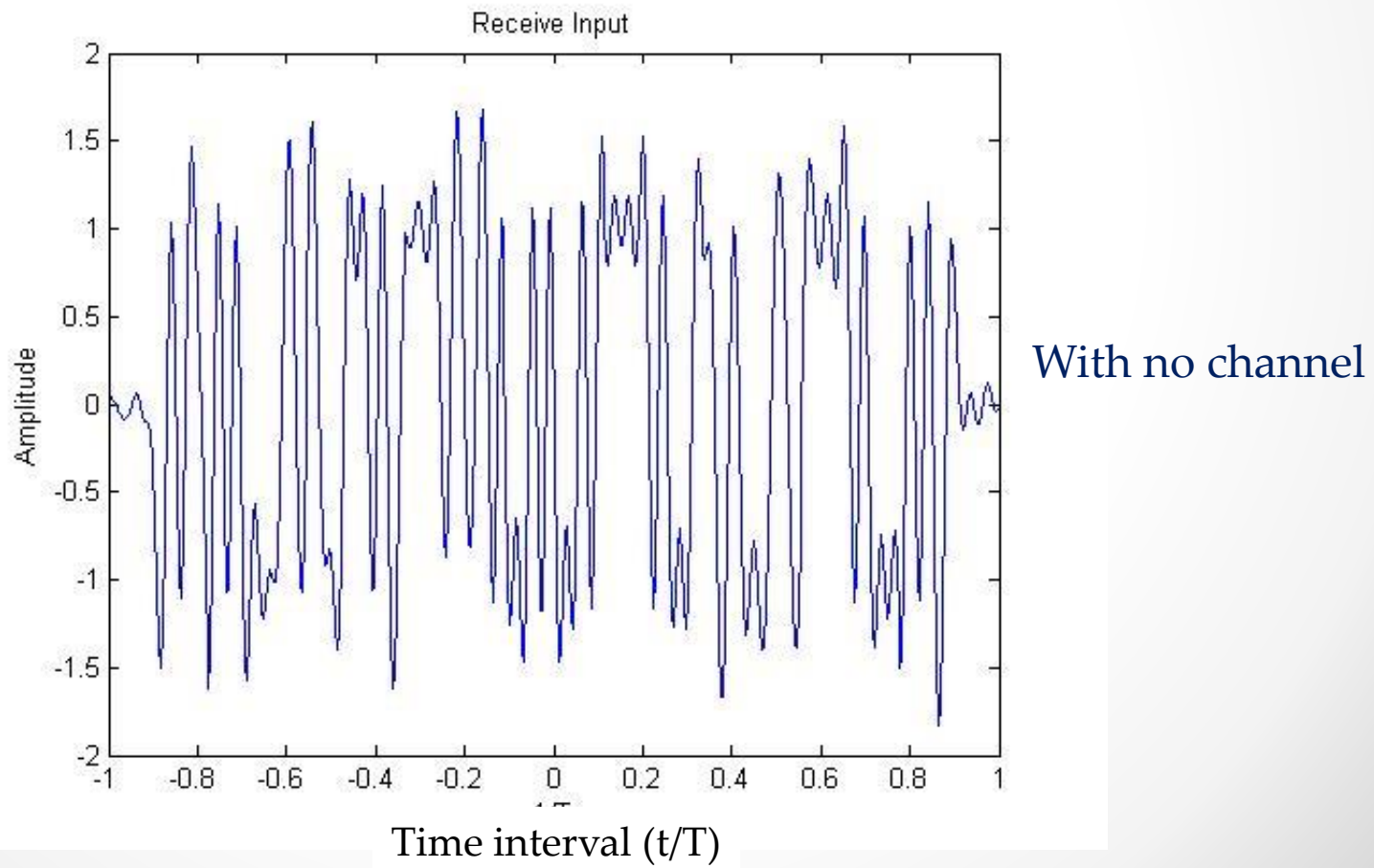
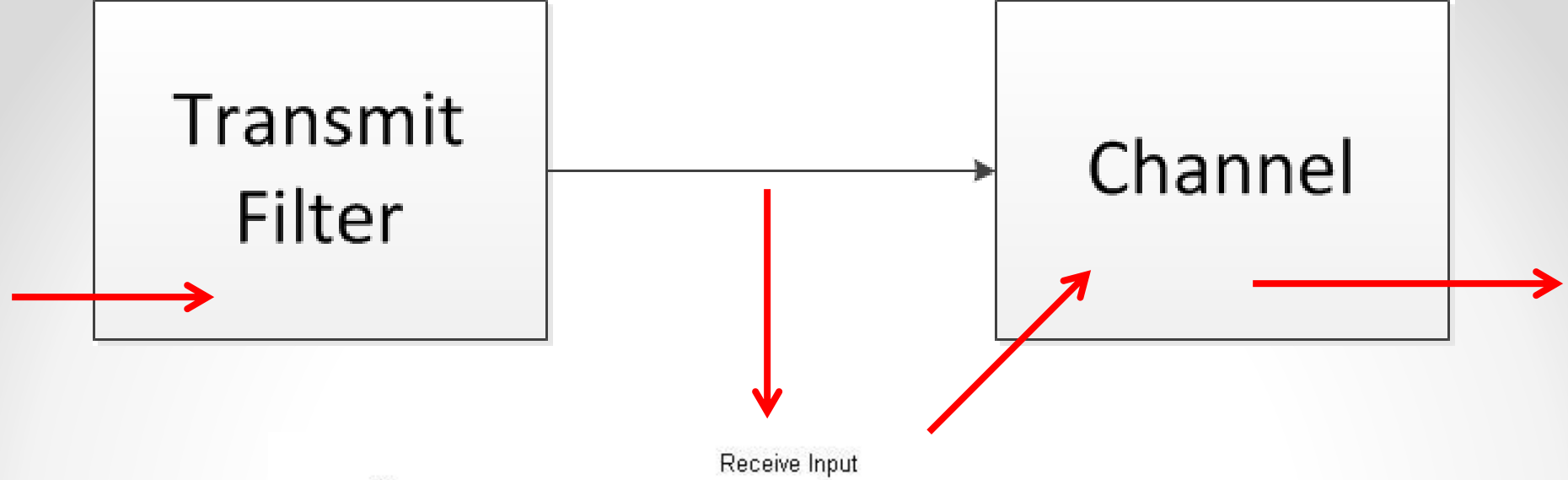


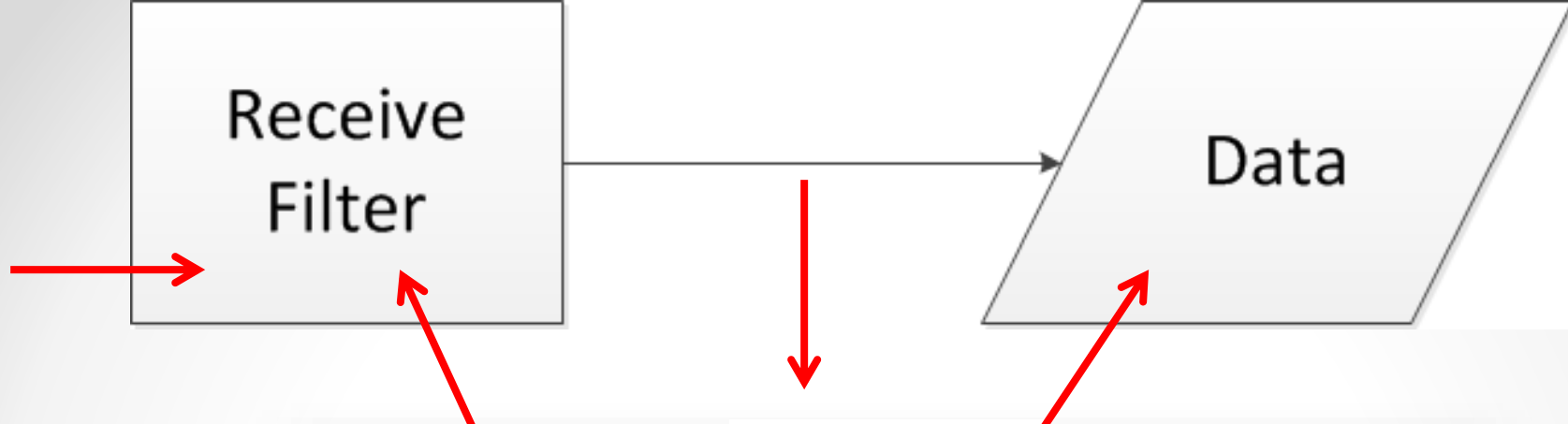
Convolution



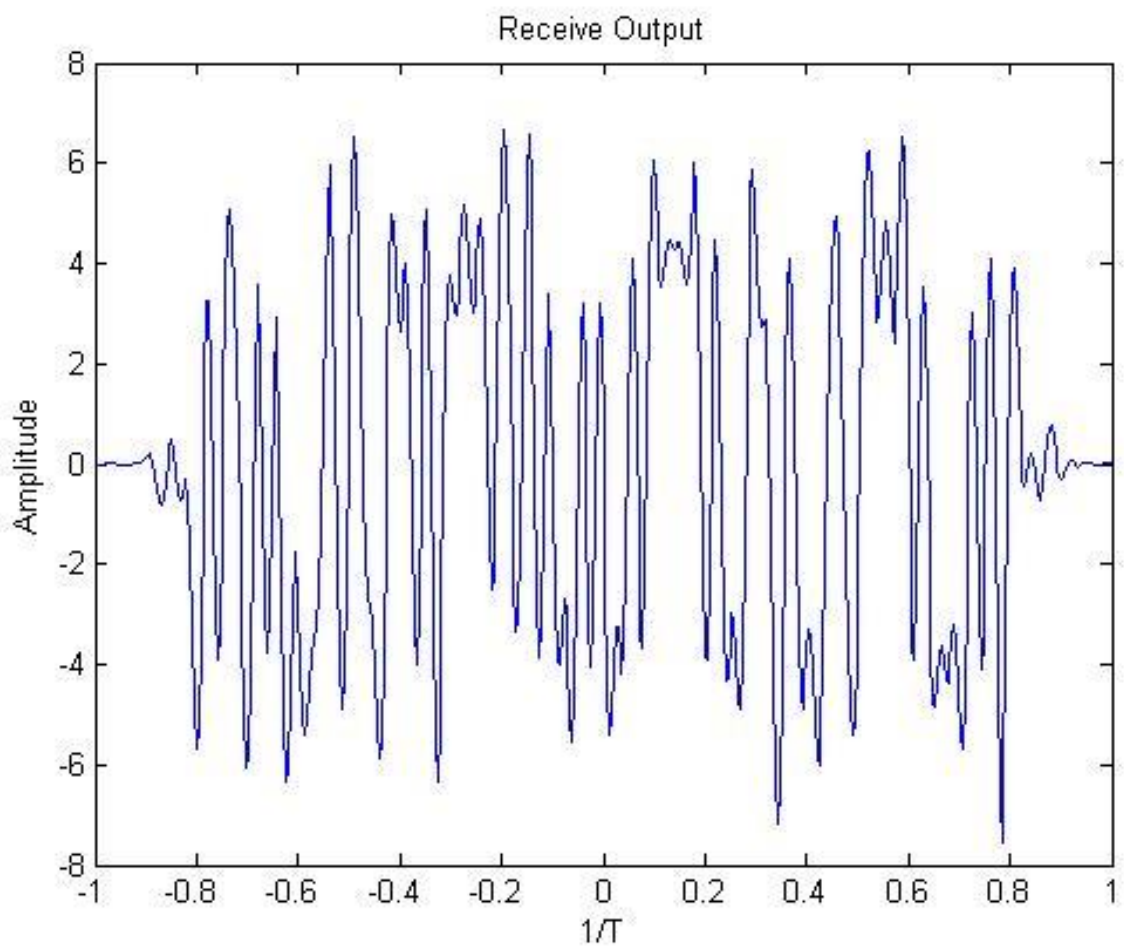
Convolution







C

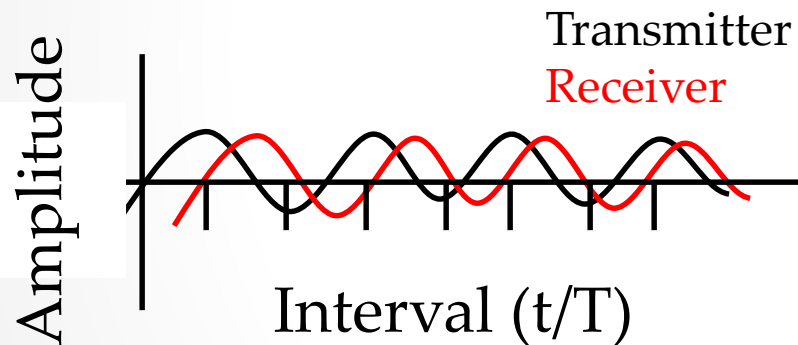


In reality, transmitters and receivers are not always perfectly synced



Example: Transmitter has a phase shift and frequency offset

- The transmitter is not in sync with the Receiver



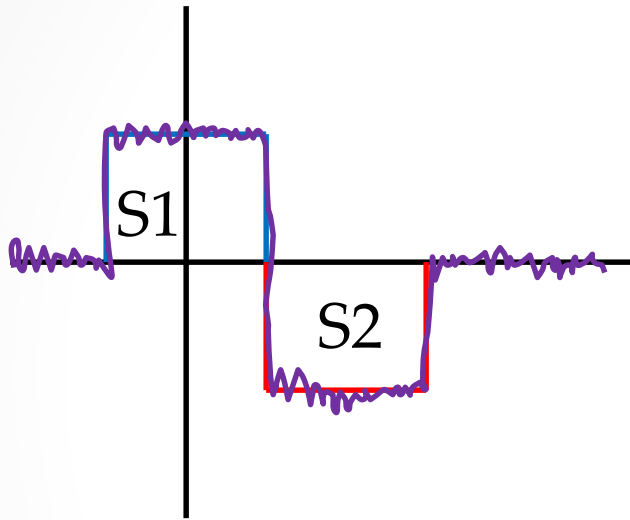
Here, input is sinusoidal

Signals are not in phase, and they vary at slightly different frequencies

Without an offset the Bit Error from transmitter to receiver was 0%

With a **phase shift $\pi/2$** and **frequency offset $1/25T$** the Bit Error from transmitter to receiver was 49%

Channel noise



Signal 1

Signal 2

Noise

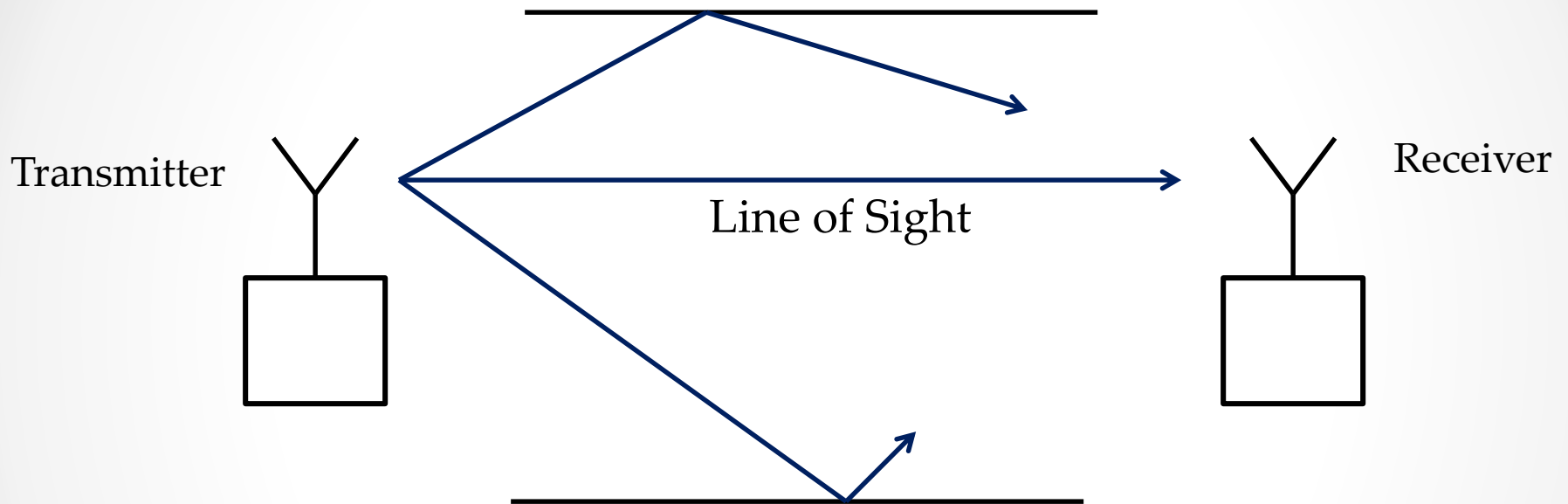
$$y(t) = x(t) + n(t)$$

$x(t)$ is the signal

$n(t)$ is the noise

$$\text{SNR} = x(t)/n(t)$$

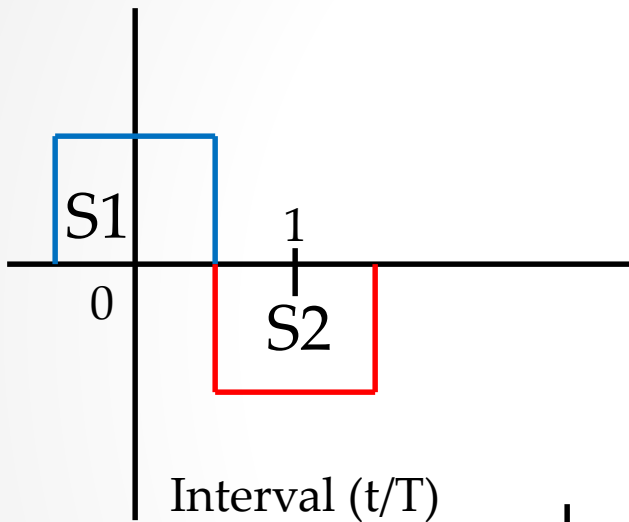
Multipath Channel



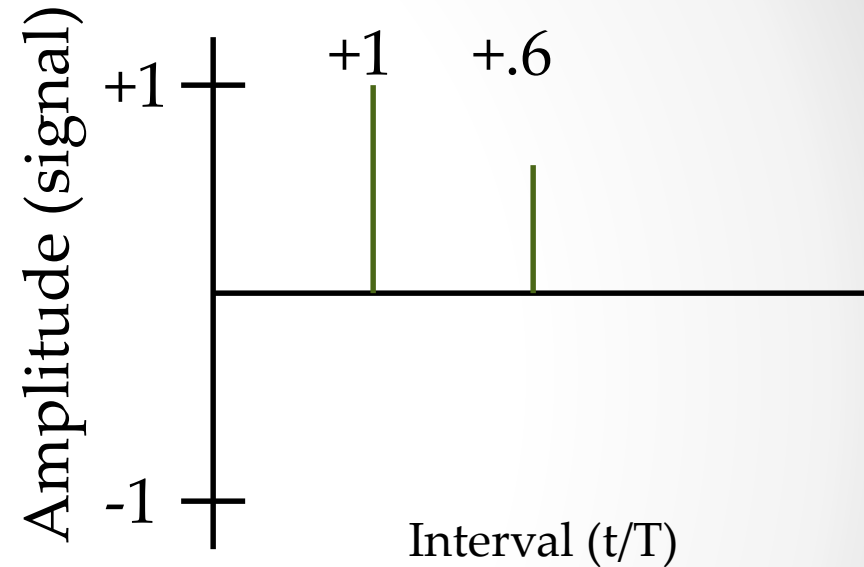
Multiple version of same signal are sent

Result of multipath

2 path channel

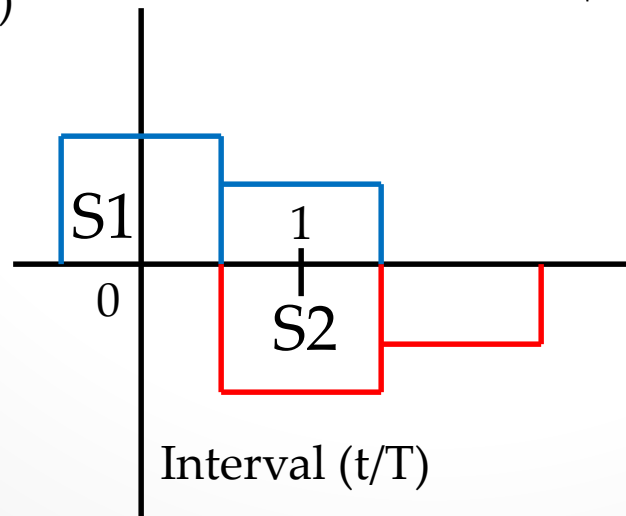


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Symbol 1

Symbol 2

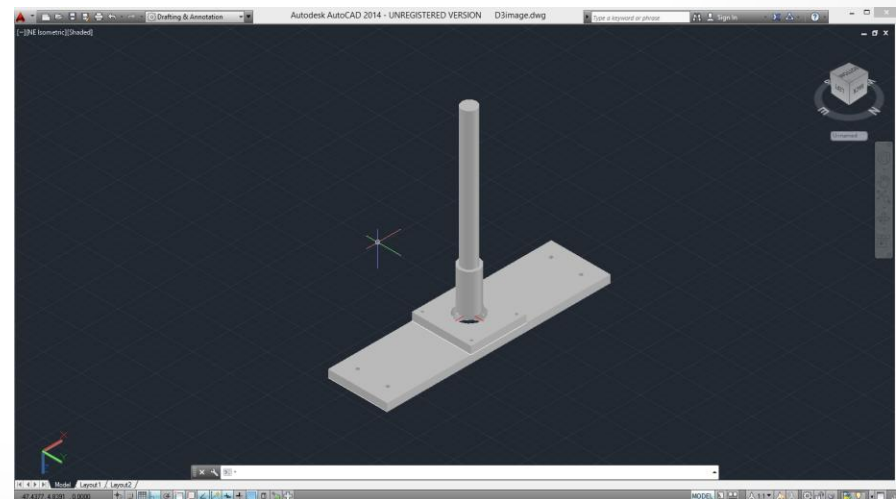
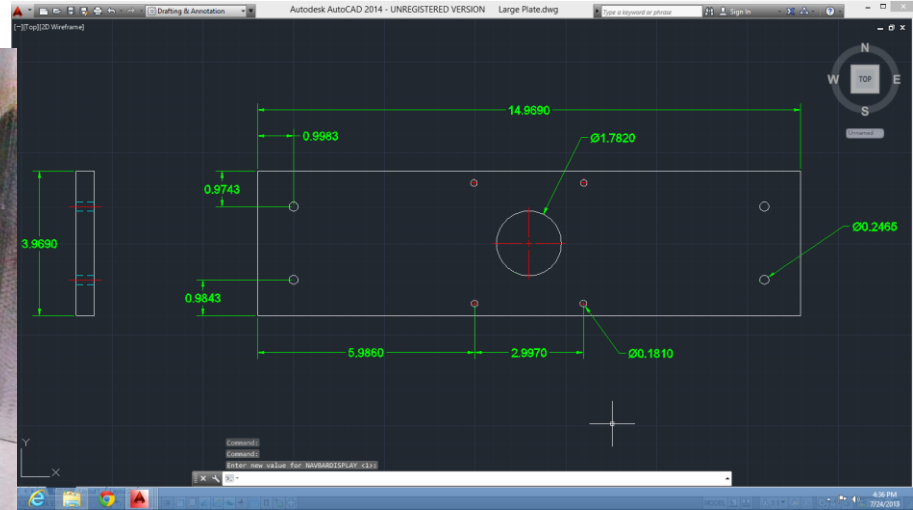
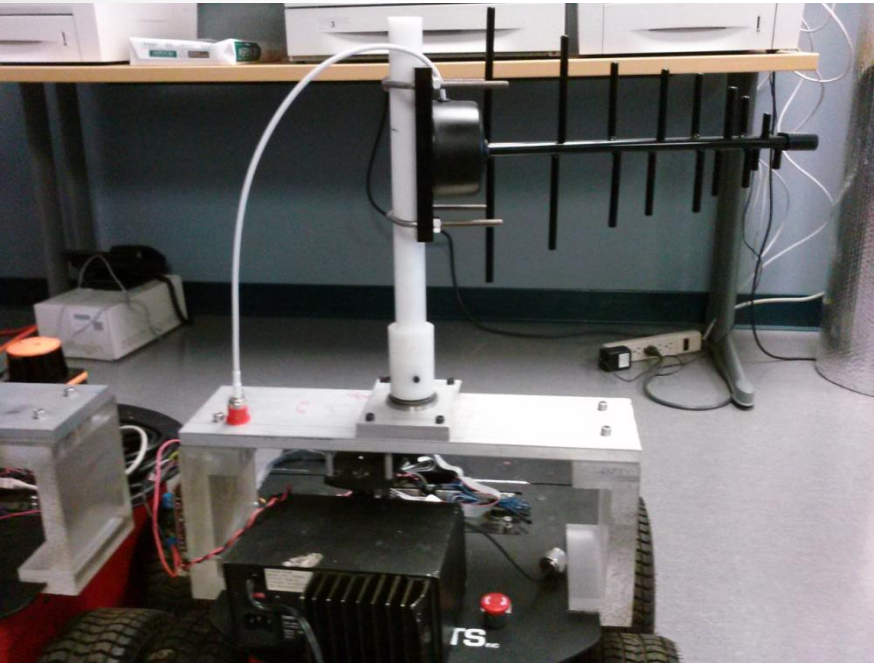


Overlapping causes Intersymbol interference

Summary of Project

- Developed expertise in MatLab, and signal processing
- Contributed to the lab by designing the antenna fixture in AutoCad

Antenna fixture model



Future work

- Still working on the simulation to reduce noise in the signal.
- Will be fabricating the model

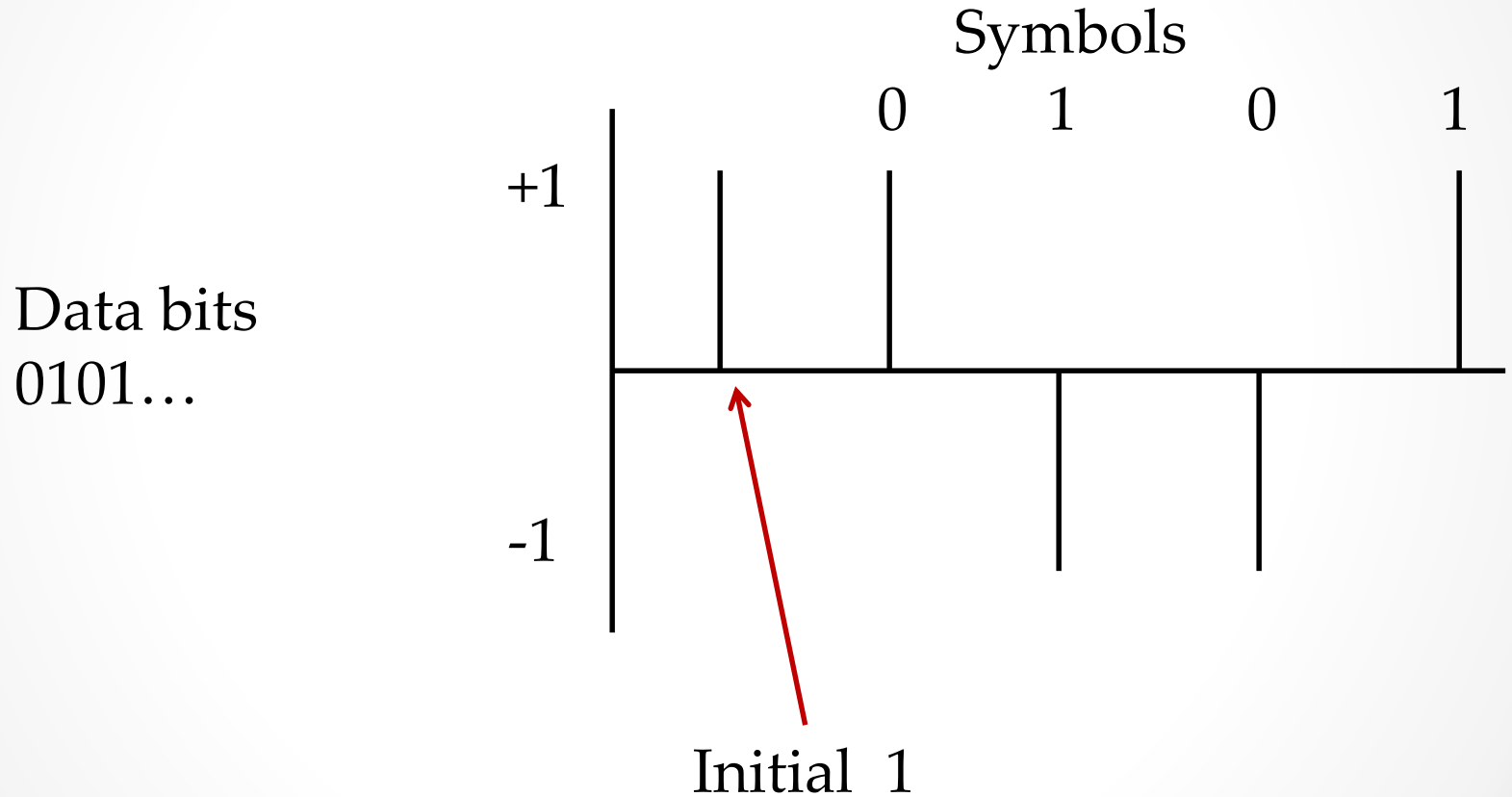
Acknowledgements

- Faculty Advisor: Yasamin Mostofi
- Mentor: Saandeep Depatla
- INSET



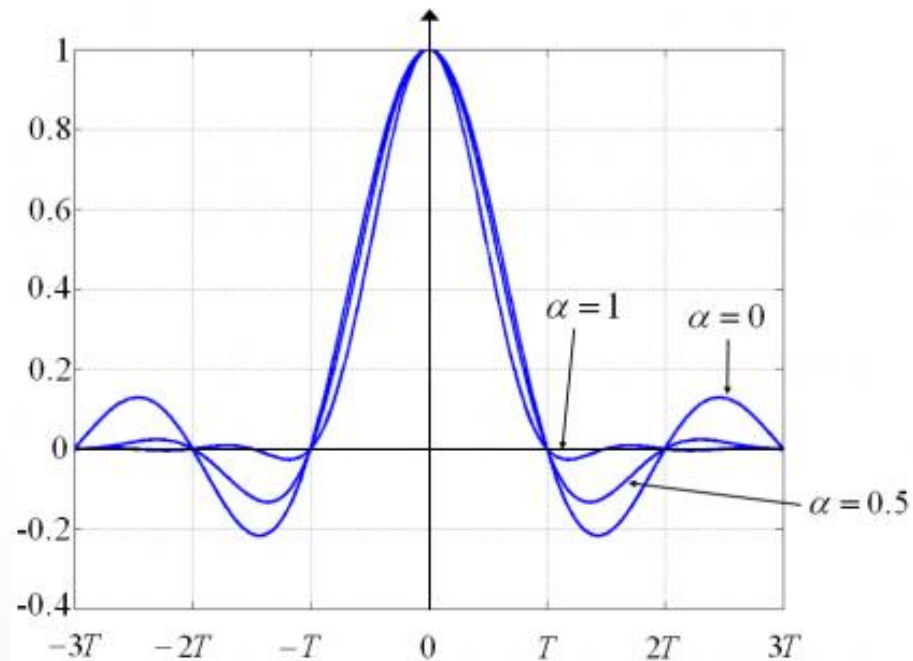
Thank You!

Differentially Encoded

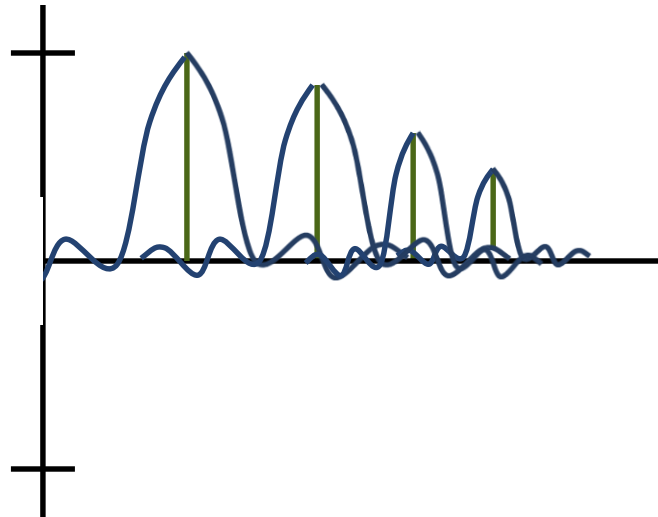


Matched filters

This is from convoluting the
transmit and receive filter ,
Raise Cosine filter



Signal after a multi channel path



A multiple path channel filter, which creates noise.
Currently working on reducing the noise created by ISI.