

# Full Duplex System for Simultaneous Transmit and Receive MRI Systems

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## Abstract

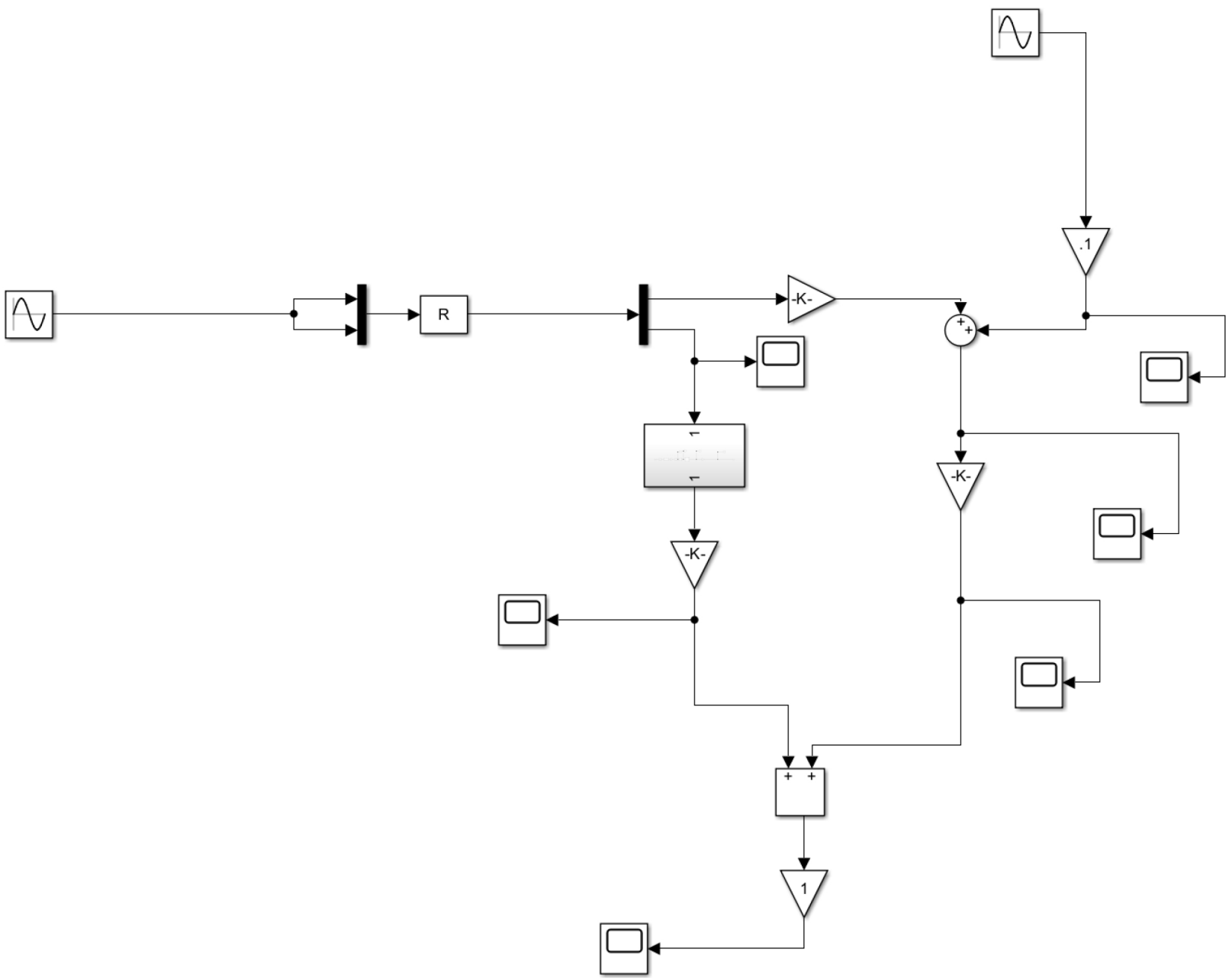
- This research project seeks to address the efficacy of using Simultaneous Transmit and Receive radio-frequency (RF) signals for next-generation safe and low-cost MRI systems.
- By cancelling the coupled signals from transmit to receive channels, a full duplex RF system can be implemented, and the desired RF MRI signals can be acquired.
- Distribution of RF power in time results in significantly reduced peak power requirements, and detection of Ultrashort relaxation times useful in analysis of certain hardmaterials.
- These factors culminate in devices which are specially suited to provide medical professionals and patients with more accurate information at lower energy costs.

## Methods

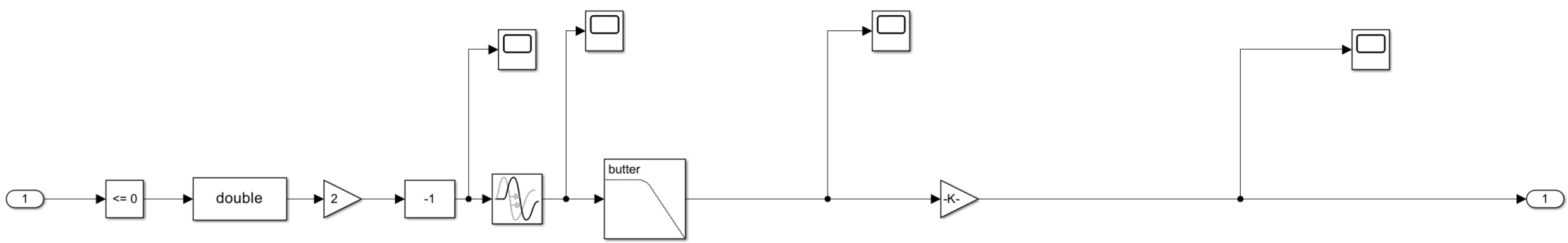
- Based off of data collected from MATLAB Simulink Circuit
  - 128 MHz MRI signal of -20dB
  - 128 MHz MRI signal of 60dB
- Interference Signal is Coupled with MRI signal
- Separate Signal can be converted to a 1-bit digital signal for programmable delay
- This delay replicates phase shift of 180 degrees
- Low Pass Filter is used for conversion back to Analog domain
- Programmable gain is used to match amplitude of interference signal
- Sampled and Coupled signals are combined to destructively cancel

Interference and reconstruct desired MRI signal

## RF Cancellation System



## Digital Conversion and Delay System



## Results

- Delay in digital domain was successful in completing 180 degree phase shift
- Sampled Signal was Successful in cancelling out coupled interference and MRI signal was partially isolated
- Proves feasibility of Full Duplex system with digital phase shift for use in STAR MRI systems
- Next steps are further reconstruction by feeding signal into amplifier
- Future work will include integration with real-world hardware and feedback systems for use with actual human bodies

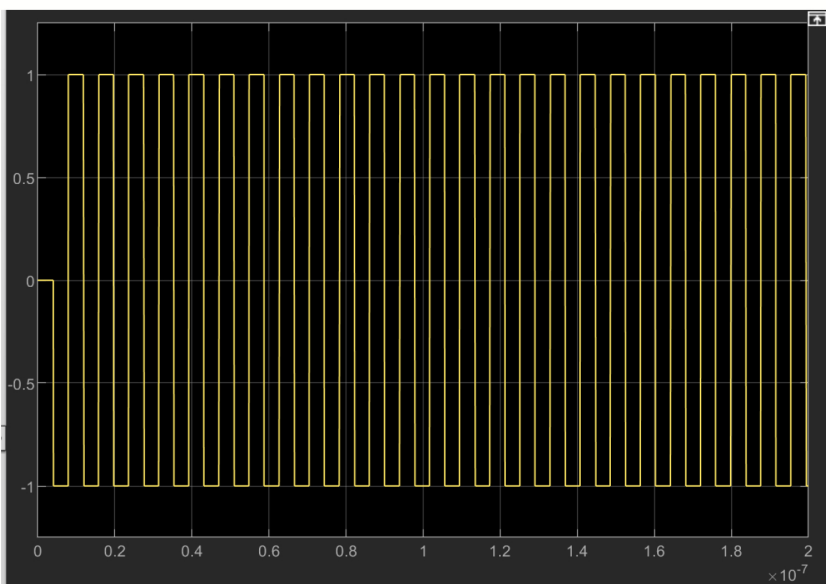


Figure 1: Phase Shifted Digital Signal

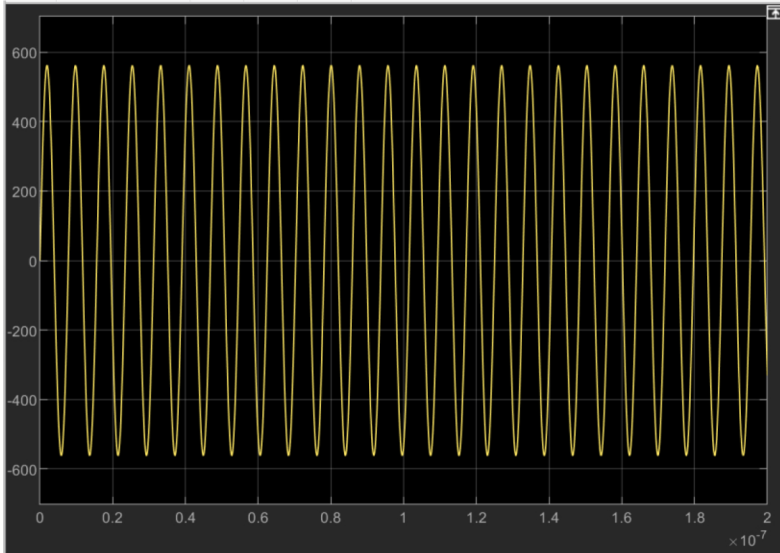


Figure 2: Coupled RF Signal with MRI and Interference

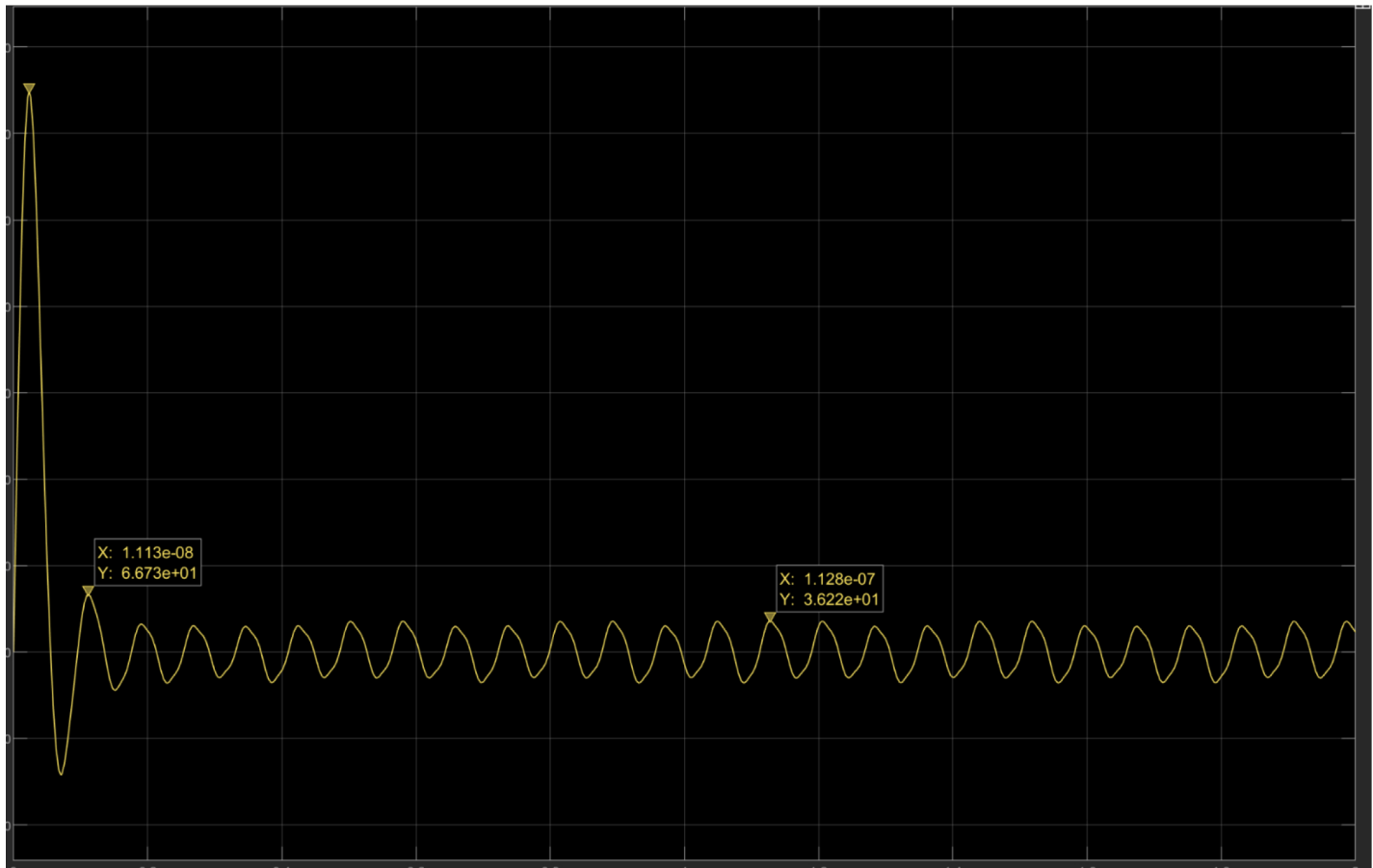


Figure 3: Isolated MRI Signal