Directional Modulation Retrodirective Array-Enabled Physical Layer Secured Transponder for Protected Wireless Data Acquisition

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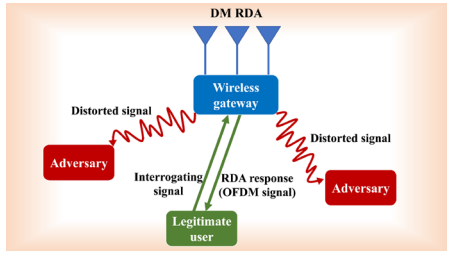
STATUS QUO

Directional Modulation Retrodirective Array (DM RDA)

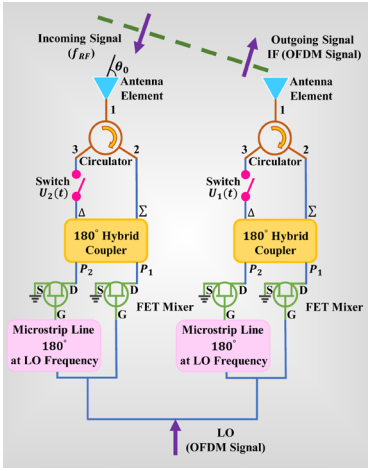


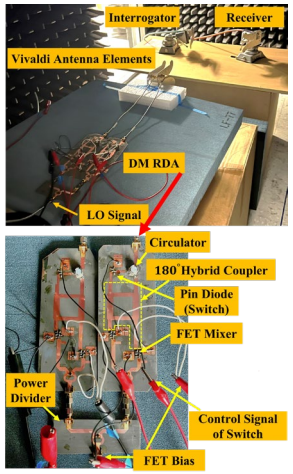
- Retransmitted signal is time-modulated by using PIN diodes as RF switches
- Directional modulation for physical layer (PHY) security in wireless communication
- Traditional security methods based on data encryption incur high complexity and communication overhead

NEW INSIGHTS

- ✓ Better security performance in comparison with a conventional RDA without time modulation
- ✓ No need for any optimization method for obtaining periodic sequences
- ✓ Low number of RDA branches
- ✓ Same polarization for the received and retransmitted signals
- ✓ Retransmitted signal is an orthogonal frequency-division multiplexing (OFDM) signal
- ✓ Physical layer secured transponder for protected wireless data acquisition

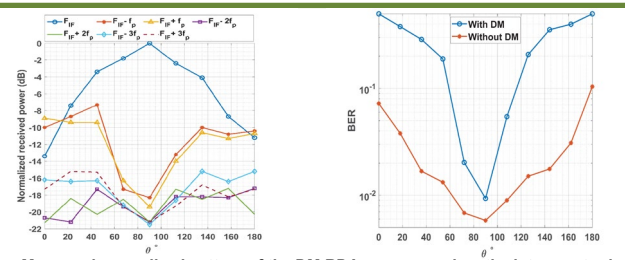
DESCRIPTION



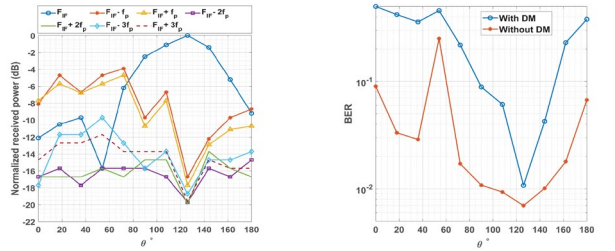


- ✓ **Phase conjugator circuit**
  - ➢ $f_{LO} = 2f_{RF}$
  - ➢ LO is injected to the gates of two field-effect transistors (FETs) employed as mixers with 180° out of phase
  - ➢ Incoming RF signal enters port 1 of the circulator; after passing from a designed 180° hybrid coupler, it is applied to the drain of FETs in phase
- ✓ **PIN diodes as RF switches in the retransmitted signal path**
  - ➢ At the Δ port, the phase conjugated IF will go to port 3 of the circulator after being time modulated by a PIN diode with a predetermined periodic sequence to achieve DM

QUANTITATIVE IMPACT



Measured normalized pattern of the DM RDA response when the interrogator is located at $\theta_0 = 90°$ and BER results



Measured normalized pattern of the DM RDA response when the interrogator is located at $\theta_0 = 126°$ and BER results

PROPOSED CONCEPT GOALS

- ✓ A time modulated DM RDA enables PHY security for wireless data transmission
- ✓ Measured BER results by injecting an OFDM signal as LO to the fabricated DM RDA prototype verify a very low BER in the interrogator direction, while a much higher BER in all other angles in comparison with a conventional RDA without DM
- ✓ Can be employed in wireless communication networks as a transponder to respond to an interrogator by transmitting PHY secured OFDM signals