NBI Mitigation for UWB Systems Using Multiple Antenna Selection Diversity

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1. Motivation

• UWB must coexist with narrowband systems
• Due to FCC regulations, NBI might a few tens of a dB higher than UWB signal.
• UWB’s inherent spreading gain might not be sufficient to mitigate NBI
• NBI might overwhelm receiver front-end
  – Need for NBI mitigation, preferably prior to acquisition

2. UWB versus NBI Spatial Energy Variation

• Extensive Indoor NLOS measurement campaign at MPRG
• UWB and NBI energy capture were measured over a small local area
• UWB power is almost constant
  – Low fading margin
  – Ability to resolve most multipath components
• NBI power varies wildly

3. Proposed System: NBI Mitigation based on Multiple Receive Antennas

• UWB energy will be constant from antenna to antenna
• NBI energy will vary independently across antennas
• Diversity gains are thus possible
• The proposed system is designed to minimize the interference power
  – Any increase in received power is most likely due to increased NBI power
• Selection diversity (SD) method
  – Select antenna with lowest received power
• SD does not require acquisition prior to NBI mitigation.
• SD requires only a single front end (a single correlator circuit).

4. System Performance

• Two types of receivers studied:
  – Perfect received (matched to received pulse shape)
  – Rake receiver
• Desired component of decision statistic:
  – Constant across antennas for perfect receiver
  – Follows Laplace distribution for Rake receiver
• Probability of error derived for Rayleigh and Ricean NBI fading

\[ P_e = Q \left( \sqrt{\frac{E_sB}{N_0}} \right) \]

\[ P_e = Q \left( \sqrt{\frac{E_sB}{N_0}} \right) = Q \left( \frac{E_sM^2}{2N (a^2+b^2) \sigma^2 + \sigma^2} \right) = Q \left( \sqrt{M \times \text{SNR}_{\text{DB}}} \right) \]

5. Results

• 6 GHz NBI tone
• Simulations based on real NLOS channel profiles
• 3-dB gain for perfect receiver in Rayleigh fading when number of antennas doubles
• Less gain for Ricean fading
• Significant diversity gains for Rake receiver

6. Relevant Publications