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Joint Positioning-Communications: Constant Information Ranging for Dynamic Spectrum Access

-Spectral congestion limits the opportunities and performance of radio frequency (RF) systems. Every RF device must share limited spectral resources, which becomes increasingly challenging as more devices are introduced into congested environments. Modern RF technologies must be supported by efficient resource management strategies and cooperation techniques to overcome spectral congestion.

RF convergence is a growing field of cooperative design techniques that enable significant performance and efficiency enhancements for a broad range of RF systems. Many of these techniques promise significantly lesser resource consumption, but they also require cooperation between different types of RF applications. These techniques offer feasible solutions for many types of RF systems, but they require a significant paradigm shift from traditional system design techniques.

Intelligent transportation systems (ITS) are increasingly popular, promising unprecedented transportation safety and efficiency. These systems, however, require several simultaneous RF services such as radar, communications, and positioning, navigation, and timing (PNT). This significantly increases spectral congestion, especially as more vehicles begin to adopt these systems.

Researchers at Arizona State University have developed a simultaneous positioning, navigation, timing, and communications system that cooperatively executes multiple radio frequency (RF) services. A constant-information ranging (CIR) strategy is used that maintains constant information learned about an incoherent moving target by modulating a revisit interval to minimize the number of interactions. This significantly reduces spectral congestion and offers a control mechanism to dynamically manage spectral access. The CIR strategy is validated in a simulation environment where a 91% reduction in spectral access for a particular flight path is observed while maintaining a 3-centimeter (cm) precision in ranging.

Related publication: Joint Positioning-Communications: Constant-Information Ranging for Dynamic Spectrum Access

Potential Applications:

- Communication and positioning, navigation, and timing (PNT) systems, such as the following:
  - Location services

- Position detection for vehicles
- Navigation systems

Benefits and Advantages:

- Reduction in spectral access by optimizing revisit time for a moving target
- Does not require knowledge of current trajectory of vehicle
- Low-cost solution in terms of computation with no need for extensive reinforcement learning or machine learning
- Configurable for specific application and/or computational capability
- Can be used in the determination of time of flight and relative clock offset