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Hyper-Precise Positioning and Communications for Radio Networks

Vehicle positioning systems assist operators in travel and operation of air and ground vehicles. For example, aircraft positioning systems assist operators in critical tasks such as landing and takeoff, particularly in low-visibility conditions. Aircraft positioning systems are also key components of remotely controlled tasks such as drone operation. Traditionally, vehicle positioning systems have contended with tradeoffs between accuracy of measurement and spectral efficiency, where higher-bandwidth signals are required for increased position resolution. Use of positioning technologies in increasingly cluttered environments only furthers technical challenges. In addition, vehicle positioning signals have traditionally been segregated from communications signals, requiring dedicated bands for each. Thus, legacy radio systems do not support modern performance requirements or user densities.

Researchers at Arizona State University have developed the Hyper-Precise Positioning and Communications (HPPC) radio network which provides users with simultaneous communication and high-precision positioning capabilities with minimal spectral requirements. The radio platforms are small and thus can be easily integrated into a variety of applications including motor vehicles, unmanned aerial systems (UAS), airplanes, base-stations, and buildings. A link in the HPPC network achieves high-accuracy positioning (sub-10 cm) using relatively low spectral resources (10 MHz bandwidth), allowing many users to operate nearby simultaneously. Optimized for compatibility with a variety of radio platforms, HPCC can offer a valuable solution when a custom system design would be prohibitively expensive.

The HPPC system combines optimizations and innovations in the areas of: radio frequency convergence, interference mitigation, signal time-of-flight estimation, position estimation, distributed coherence, timing protocols, tracking methods, and single co-use waveforms.

Potential Applications:

- Communication-based location services
- Aircraft position detection
- Ground vehicle position detection
- Navigation for automated air and ground vehicles

Benefits and Advantages:

- Efficient – Produces high-precision position estimates with significantly fewer spectral resources than comparable techniques such as radar and global positioning systems (GPS)
- Self-Contained – Does not require external infrastructure (such as a mesh of satellites)
- Secure – Features encrypted communication to guard against spoofing and adversarial interference
- Versatile – Compatible with existing platforms and standard, consumer-grade software-defined radios