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Simultaneous Communications and Precision Vehicle Positioning

Background

Location services are becoming increasingly important in cellular systems and are used in applications such as emergency 911 calls and location-based billing. In the past, single methods of determining a mobile station's position have been used; however, using a single method often results of ambiguities or errors. For example, in Code Division Multiple Access systems (CDMA), a time difference of arrival (TDOA) measurement is used to determine a hyperbola along which the mobile may be located. This is calculated using the phase or chip offset of pilot signals received from two different base stations by a mobile terminal. Unfortunately, this method is not always available because the terminal may not be able to receive a pilot signal from more than one base station.

Invention Description

Research at Arizona State University has resulted in a positioning method that uses information obtained from one or multiple base stations to calculate a mobile terminal's location in a cellular system by combining multiple estimated locations. This is achieved through MIMO communications waveforms with phase recovery, distributed coherence techniques, and decoding/remodulation techniques, which together enable superior positioning accuracy.

In one embodiment, the estimated locations are averaged using a weighted sum, where the weights reflect the quality of information or data that produced the estimated location. The estimated locations are based on information such as time difference of arrival (TDOA), time of arrival (TOA), and angle of arrival (AOA). The round-trip delay (RTD) provides TOA information, and the pilot strength measurement messages (PSMM) contain the TDOA information, AOA information, and the ID of base stations that provide signals to the mobile terminal.

Potential Applications

- Communication-based location services
- Aircraft position detection
- Ground vehicle position detection

- Navigation for automated air and ground vehicles

Benefits and Advantages

- Achieves positioning accuracy far better than current or traditional approaches
- Naturally secure as it relies upon a communications link that can be encrypted, unlike GPS
- Requires minimal spectral allocations

Research Homepage of Professor Daniel Bliss