Acoustic Positioning with Unsynchronized Sound Sources

In recent years, cellular phones are widely used for GPS-based navigation. There is a growing demand to provide navigation with cellular phones in areas where GPS signals can't be received such as in airports, hospital, shopping centers and underground parking lots. Furthermore, it is required to provide better than GPS accuracy for locating products in a supermarket, finding rental cars pickup spots or a hotel room door in a corridor.

In this demonstration we present a positioning system for cellular phones, based on *unsynchronized* acoustic signals. Since all cellular phones can operate at a sampling rate of 44,100 samples per second, acoustic signals beyond the human hearing range are used. The demonstrated system consists of three beacons in fixed positions, multiple cellular phones, and a cloud server which controls the beacons and cellular phones. The advantage and uniqueness of the demonstrated system is its ability to provide accurate positioning of many users, based on merely three acoustic signals transmissions from fixed beacons, while there is no common clock source in the system and each beacon and smartphone are operating with their own local, unsynchronized clock source.

The method in which the system operates without a common clock source is that each device (beacon or cellular phone) measures the time delay between signals from all devices, including their own emitted signals. The measurements results are uploaded to a cloud server which computes the cellular phones positions according to the uploaded timing parameters and the known beacons positons.

The user interface is comprised of a simple "Find" button requesting the server to position all the devices connected to it at the same area as the user, and then the application displays the distance between specific users or shows the location of users on a map.

In the enclosed movie, an acoustic positioning system controlled by a cloud server is demonstrated, working in two modes: Active and Passive. In Active mode, the smartphones are transmitting and receiving acoustic signals. In Passive mode, three beacons are transmitting unsynchronized acoustic signals, while the smartphones are passive, i.e. only receiving acoustic signals. A cloud server calculates and provides the distance between their locations.

We would be honored and delighted show this demonstration at ICASSP 2018