Ultrasound positioning for use indoors comes in various flavors and can be distinguished by whether they measure time-of-flight (TOF) or received signal strength (RSS). The various systems, their applications, their strengths, and their weaknesses will be discussed.

TOF is measured with reference to a radio signal to get ultrasound time-of- arrival (TOA). Line-of-sight to three or more nodes is required for 3-D positioning. Accuracy is in the cm or sub-cm range. A radio-free alternative can be made if time-difference-of-arrival (TDOA) is measured instead. Some years ago we demonstrated such a system with a wearable ultrasound transmitter. At least 4 nodes were required for 3-D, but we used 8 in order to have redundancy in case of obstructed nodes.

The simplest RSS-system are binary and will just determine if the ultrasound signal can be detected or not. This is used on its own for room-level positioning. Another important application is in assisting RSS-based RF-systems such as WiFi positioning. The ultrasound RSS-system helps reduce the number of large errors (5-10 m) of the WiFi-system. Such systems are deployed world-wide today by companies like Sonitor and Aeroscout.

We have just demonstrated that RSS-based ultrasound positioning can be done with accuracies in the 10 cm range. This parallels the ubiquitous RF-based RSS systems and requires a propagation model. For ultrasound it involves spherical spreading and absorption. The received signal strength from at least three nodes is required. Such a system will be presented in a separate submission to IPIN 2012.

There are also hybrid systems where the echo structure inherent in the time history of the received signal is analyzed. Both the amplitude and time information is used in order to position the node relative to walls, ceiling and floor of the room.