**3D Tracking via Body Radio Reflections (C02)**

Current RF localization systems require users to hold a transceiver and are not very accurate. WiTrack is a system that more accurately tracks 3D motion of a user from radio signals reflected off their body without the use of any wireless device. Such a system can be used to integrate RF-based localization systems and human-computer interaction systems in order to expand reach beyond direct line of sight and enable through-wall human-computer interaction. The main challenges are measuring time of flight of RF signals, which are addressed using FMCW, and multipath effects, which are addressed by filtering out noise in signals. The prototype is tested against the VICON motion capture system to determine accuracy, with results showing average measurement accuracy of 10-13 cm in the x and y dimensions, 21 cm in the z dimension, and was able to identify the direction of a pointing hand within 11.2o.  
**Location Systems for Ubiquitous Computing (D01)**

Emerging mobile computing applications need to know the location of tangibles in order to be useful to humans. Over the years, many systems have addressed the problem of location sensing, but each approach solves a slightly different problem and vary from each other in many parameters. In order to make sense of the plethora of tools available, the authors of the paper developed a taxonomy to help developers of location-aware applications better evaluate their options when choosing location-sensing system. The authors discuss several issues that come with different implementations: physical/symbolic location, accuracy/precision, scale, etc., and finally introduce some location systems that are representative of the field: Active Badge, Active Bat, Cricket, Radar, etc. Finally, the authors go into directions of future research: Smart Floor, E911, sensor fusion, etc.

**SurroundSense: Mobile Phone Localization via Ambience Fingerprinting (D02)**

SurroundSense aims to utilize the increasing number of sensors on mobile phones (e.g. accelerometers, cameras, microphones) to construct an identifiable fingerprint for logical localization, and therefore opening new possibilities in indoor localization. The authors aim to eliminate problems with current localization (i.e. the unscalable solution of installing localization equipment in every logical place) by combining ambient sound, light, and color in order to create a more accurate localization fingerprint. The key challenges are fingerprint generation, which is created using on-board sensor data, and matching, which uses four filtering/matching operations into an enveloping module that outputs the phone’s logical location. The prototype is evaluated using partially controlled experiments, once where phones are held in users’ hands throughout the duration of the test and another time where users mimic customer behavior. From evaluating 51 different stores, SurroundSense achieved an average accuracy of 87% when all sensing modalities were employed.  
**RADAR: An In-Building RF-based User Location and Tracking System (D08)**

RADAR is a RF-based system for locating and tracking users inside buildings that aims to locate and track mobile users in order to enable location-aware services and applications. RADAR uses signal strength information gathered from multiple sensors in order to triangulate (both empirically-determined and theoretically-computed) the user’s location. The main challenge of accurate triangulation is evaluated empirically through using data collection and NNSS algorithm, and computed theoretically using the a radio propagation model. Using the empirical method, the median error distance is 2-3 meters, whereas the propagation method is not as accurate as the empirical method, but is significantly more cost effective to deploy.

The localization unit drew my attention because it showed me the endless avenues of technological development in contemporary times. Before going through the papers, the challenges and potential applications of signal localization never crossed my mind. But now that I know of their existence, I’m definitely going to continue to dig deeper and read more about how we can leverage signal localization to create futuristic products (e.g. the automatic unlock feature on current Teslas when a driver’s key fob approaches the car door).