Localization system for healthcare and emergency response applications

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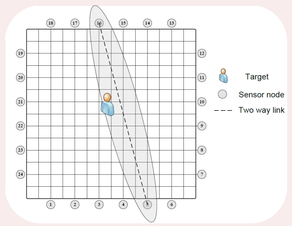
Introduction

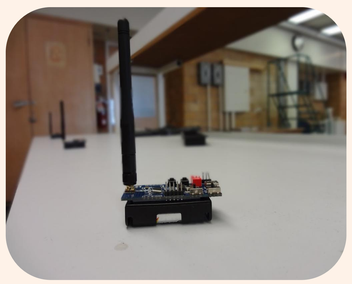
- Tracking of humans in indoor environments has many applications in the **healthcare** segment. They can be used for example –
  - to track clinicians and patients
  - to monitor people in old age home for prolonged inactivity
- Device free tracking is an effective and non-intrusive way to achieve this.
- It also has applications in **search-and-rescue operations**, **military surveillance,** etc.
- **Radio-frequency (RF) tomography** is an example of one such technology which can detect and track targets within the monitored area based on the attenuation and fluctuations caused in RF wireless transmissions.
- Wireless networks of radio-frequency sensors have the advantages – **easy deployment, inexpensive and transparent to non-metallic obstructions.**
- Indoor tracking is significantly more challenging than outdoor tracking because of the presence of multiple obstructions and this requires careful modelling of measurements.

Problem statement



Radio frequency sensors

- Experiments performed at **three sites** having different nature of indoor obstructions.
- A network of **24/28 sensors** is used to collect data.
- The sensor nodes are using system-on-chip (SoC) **TI CC 2530** transceivers.

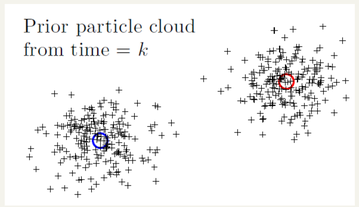


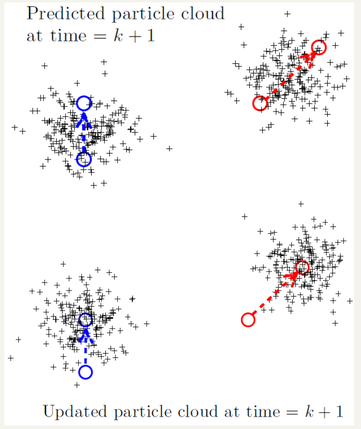
RF Sensor network

- The measurement model links the measurement vector z to the system state X.

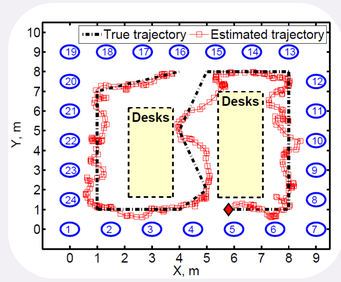
Algorithms

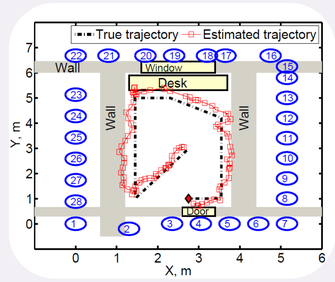
- Tracking is achieved using **particle implementation** of various filters.
- Particle based filters such as SIR, MPF, MCMC.
- Random finite set based filters such as PHD, CPHD and multi-Bernoulli filters.



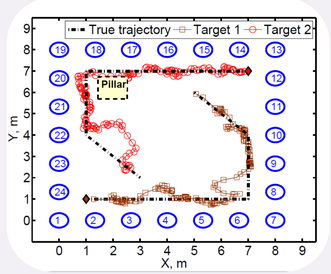


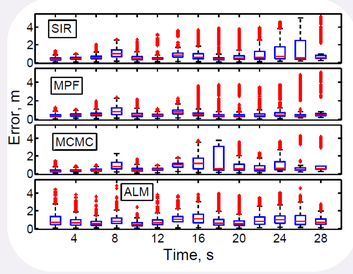
Results





True and estimated target tracks for single target tracking in different indoor environments – with heavy desks **(left)**, through-wall tracking **(right)**





(Left) True and estimated trajectory when two targets are present.
(Right) Box-and-whisker error plot for different algorithms.

Conclusions

- A novel empirical measurement model for the RF Tomography problem has been proposed for multi-target tracking in indoor environments.
- Tracking of multiple targets has been demonstrated for data collected from different indoor locations representing a variety of measurement challenges.

References

[1] S. Nannuru, Y. Li, Y. Zeng, M. Coates, and B. Yang, "Radio frequency tomography for passive indoor multi-target tracking," *To appear, IEEE Trans. Mobile Computing*, Dec 2013.
[2] S. Nannuru, Y. Li, M. Coates, and B. Yang, "Multi-target device-free tracking using radio frequency tomography," I*n Proc. ISSNIP*, Adelaide, Dec. 2011.