Exploiting Space-time Correlations in an RFID Tag Field for Localization and Tracking

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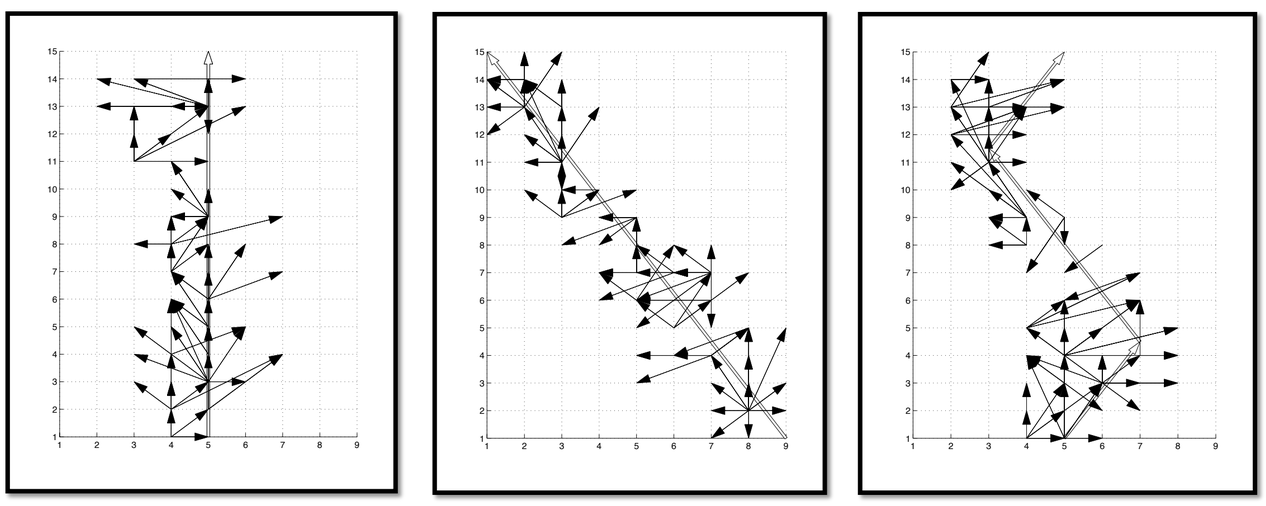
Passive RFID Tag Field

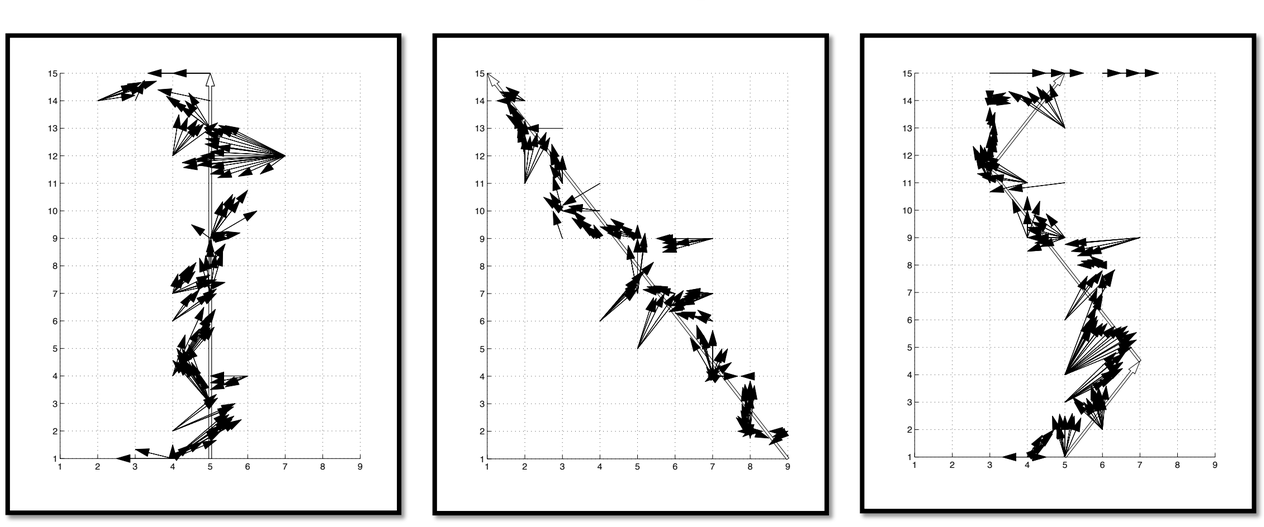
- Stationary tags distributed densely over large physical area
- Tags have storage memory
- Tags can fail temporarily (or scans can be inaccurate)
- Tags can fail permanently due to environmental conditions such as weather
- Tags are cheap, can be replaced
- System decays gracefully, according to deployment and maintenance of tags; it is robust
- Users move through tag field with RFID interrogators
- A user scans a subset of tags in a space-time locality; those tags are *space-time correlated*

Motorola MC9090-G RFID reader.

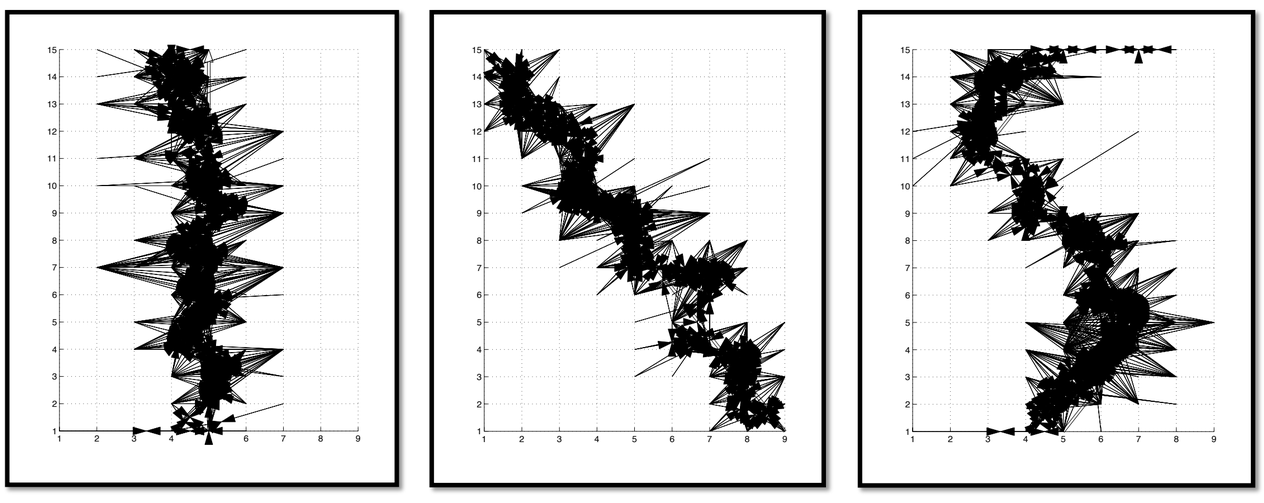
RFID tag field.



Arrow field with $\mathbf{d}^{(new)}$ from one run. Antenna power = P_2.



Arrow field with $\mathbf{d}^{(cen)}$ from one run. Antenna power = P_2.



Arrow field with $\mathbf{d}^{(sar,new)}$ from one run. Antenna power = P_3.

Space-time Correlations

- Store space-time correlation information in the tags themselves (inline storage)
- One scan results in one weighted arrow, which is the result of a *correlation function*
- Possible weightings are “equal”, “number of tags”, and “inverse max entrance time difference”
- Possible directions are “oldest to newest” and “oldest to centroid”

Experimentation

- Walk through a tag grid with an interrogator, scanning tags
- Record space-time correlations
- Compare the weighted arrows with the original trajectory
- Use different metrics depending on the application – localization and tracking; search and rescue

References

- D. Hahnel, W. Burgard, D. Fox, K. Fishkin, and M. Philipose, “Mapping and Localization with RFID,” Apr. 2004.
- J. Bohn and F. Mattern, “Super-Distributed RFID Tag Infrastructures,” Nov. 2004.