首届致远学术节
学生科研成果展示

Large-scale Wireless Fingerprints Prediction for Cellular Network Positioning

Xinyu Wu, Xiaohua Tian, Xinbing Wang

Accepted by *IEEE International Conference on Computer Communications* (*INFOCOM*) 2018. Acceptance Rate: **309/1606=19.2%**

Background & Motivations

Cellular network positioning is a mandatory requirement for localizing emergency callers, such as E911 in North America. Although smartphones are normally with GPS modules, there are still a large number of users with cell phones only as basic devices, and GPS could be ineffective in urban canyon environments.

Goals:

--Realizing fingerprinting positioning outdoors.

--Overcoming the weakness of GPS in urban areas.

Major Challenge:

--Collecting geo-tagged fingerprints in vast areas.

Methodology:

1. Fingerprint Mechanism Design

--Formulating as a **matrix completion** problem.

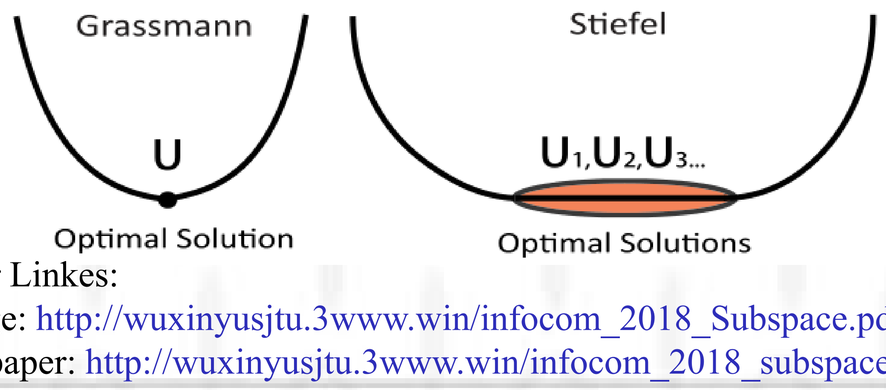
$$\min_{\Omega,\hat{A}} \ ||P_\Omega(A) - P_\Omega(\hat{A})||, \quad s.t. |\Omega| \le |\Omega_m|, \quad \xrightarrow{\textbf{SVD}} \quad \min_{\substack{U_d:m\times d \\ w_j:d\times 1}} \sum_{j=1}^{n} ||[U_d w_j]_\Omega - [a_j]_\Omega||_2^2,$$

--Solving it by **Stiefel Manifold Optimization.**

- Optimizing the orthonormal bases in a subspace (U_d)
  - Deriving the iteration function: $U_{t+1} = U_t + 2\eta_t \frac{r_t w_t^T}{||r_t||||w_t||}$,
  - Determining the best step length: $\eta_t = \frac{1}{2}\frac{||r_t||}{||w_t||}$.

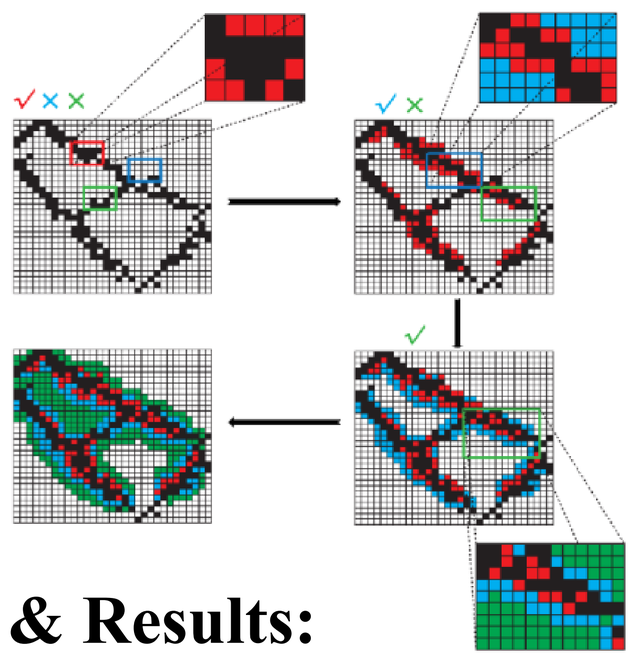
--Proving the **faster convergence rate** than Grassmann Manifold Optimization.

Intuitive Explanation:
Finer Solution Granularity



2. Sliding-Window Mechanism

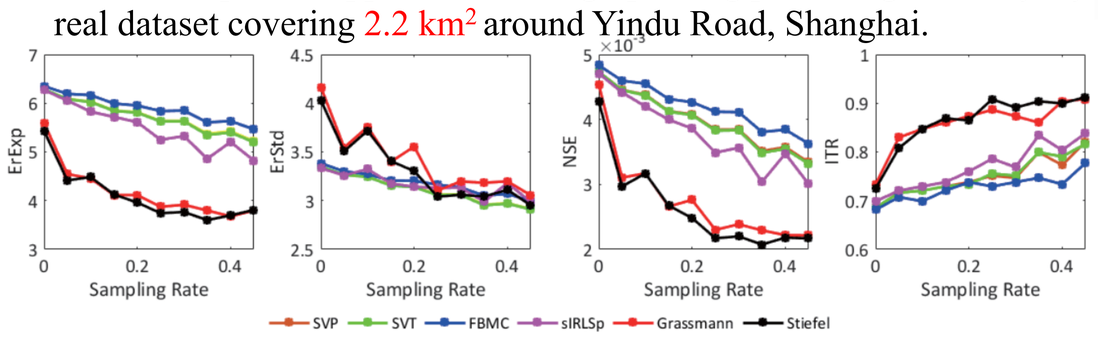
--Overcoming the problem of sample sparsity in outdoor situations

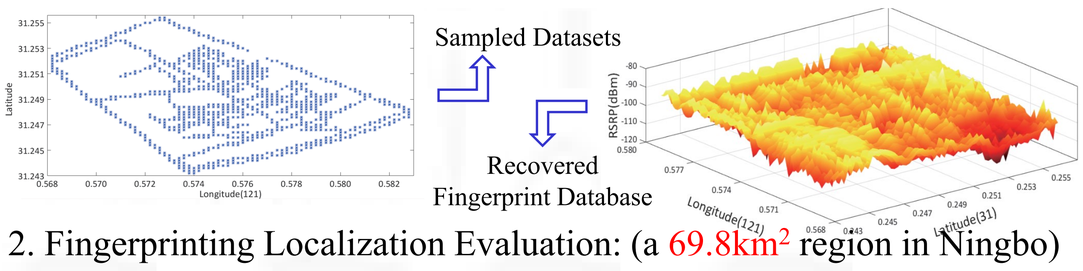


Experiments & Results:

1. Fingerprinting Prediction Evaluation:

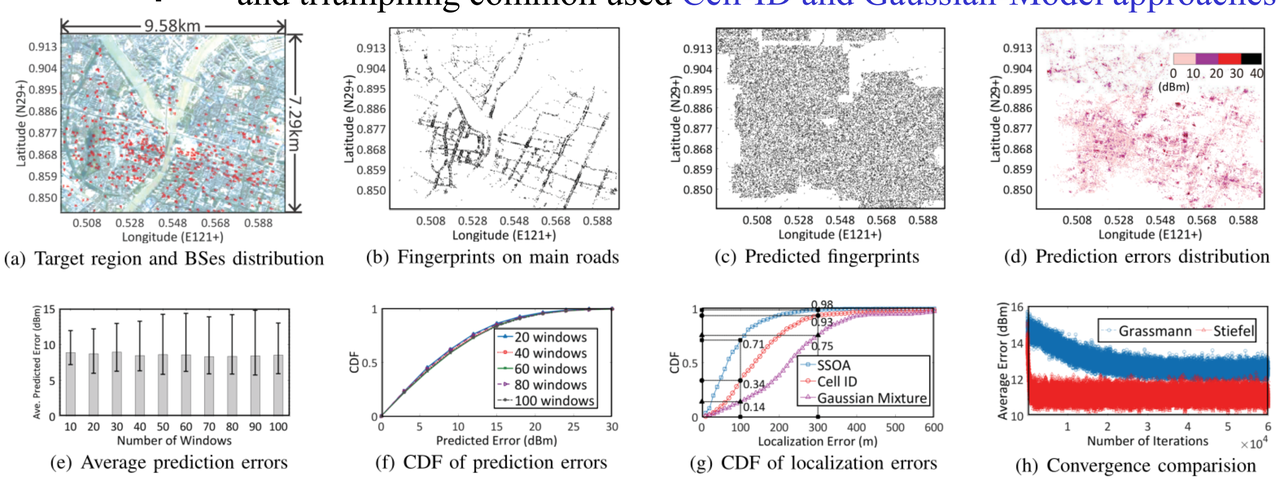
➢ Showing that our Stiefel-manifold based algorithm outperforms various matrix completion approaches in fingerprinting predicting accuracy, by a real dataset covering 2.2 km^2 around Yindu Road, Shanghai.





2. Fingerprinting Localization Evaluation: (a 69.8km^2 region in Ningbo)

➢ Showing that our Stiefel-manifold based algorithm can locate 71% and 98% users within an error of 100m and 300m respectively, which met the localizing requirement regulated by FCC E911: "100m 67%, 300m 90%", and triumphing common used Cell-ID and Gaussian-Model approaches



Paper Linkes:

9-page: http://wuxinyusjtu.3www.win/infocom_2018_Subspace.pdf

Full paper: http://wuxinyusjtu.3www.win/infocom_2018_subspace-full.pdf

个人信息： 吴昕宇，2014级，工科
邮　　箱： wuxinyu@sjtu.edu.cn