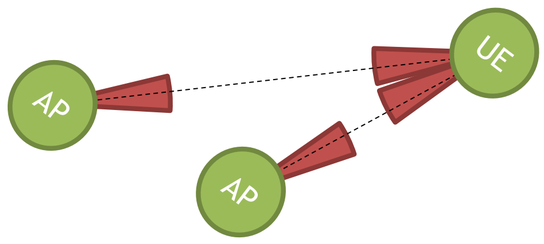
JADE: Zero-Knowledge Device Localization and Environment Mapping for Millimeter Wave Systems

Joan Palacios[1,2], Paolo Casari[1], Joerg Widmer[1]

[1] IMDEA Networks Institute, Madrid, Spain

[2] University Carlos III of Madrid, Madrid, Spain

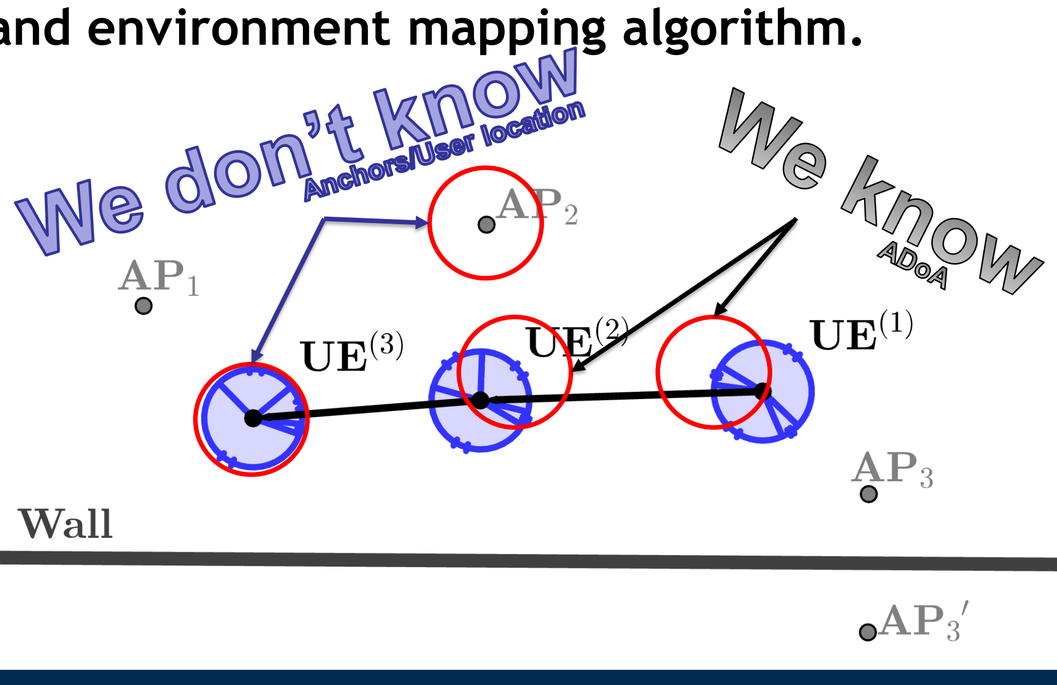
Introduction



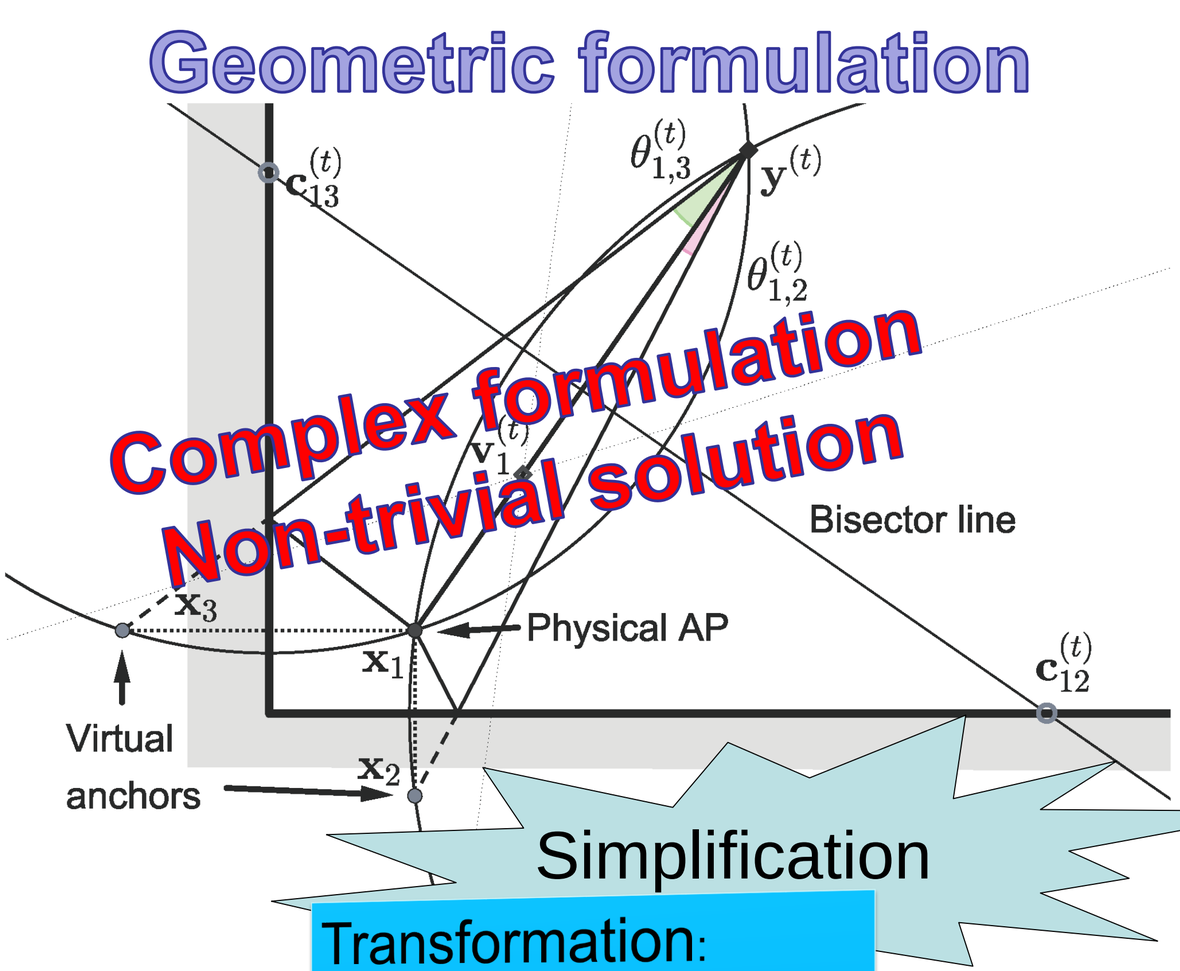
mmWave became a promising solution for 5G.

ADoA (Angle Difference of Arrival) is derived from the beam-training.

We want to create a zero-knowledge location and environment mapping algorithm.



Formulation



Yields to a formulation depending on 2 sets of variables $\{x_i\}$, the set of Anchors locations and $\left\{v_i^{(t)}\right\}$, the set of transformed user locations.
If any set is known, the other set can be derived.
This formulation is used to create an iterative refinement algorithm.

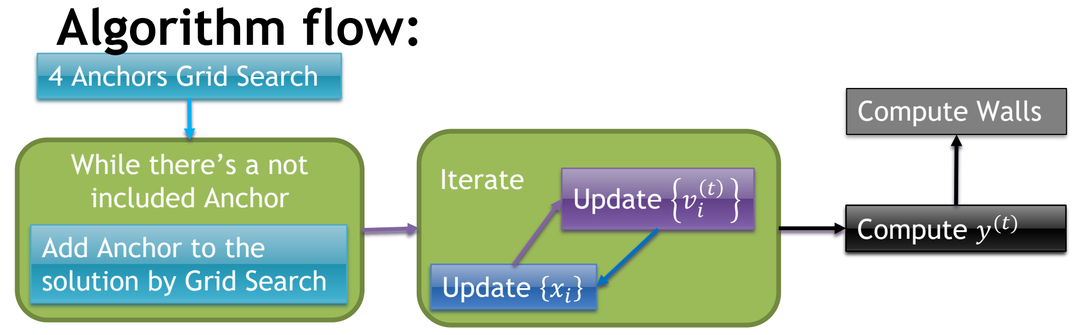
Algorithm

We create an iterative algorithm to find the solution

Methods:

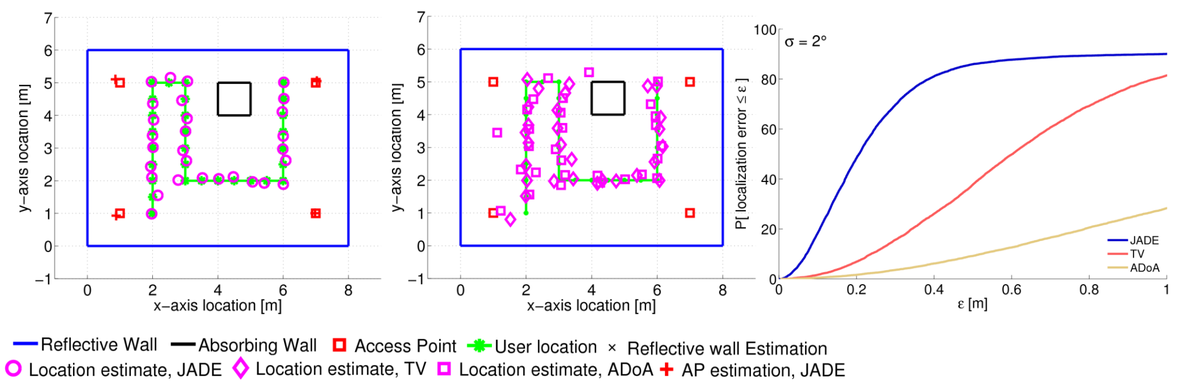
1. Objective function of $\{x_i\}$ independent from $\left\{v_i^{(t)}\right\}$
2. Compute $\left\{v_i^{(t)}\right\}$ from $\{x_i\}$
3. Compute $\{x_i\}$ from $\left\{v_i^{(t)}\right\}$
4. Compute $\left\{y^{(t)}\right\}$ from $\{x_i\}$ and $\left\{v_i^{(t)}\right\}$

Algorithm flow:

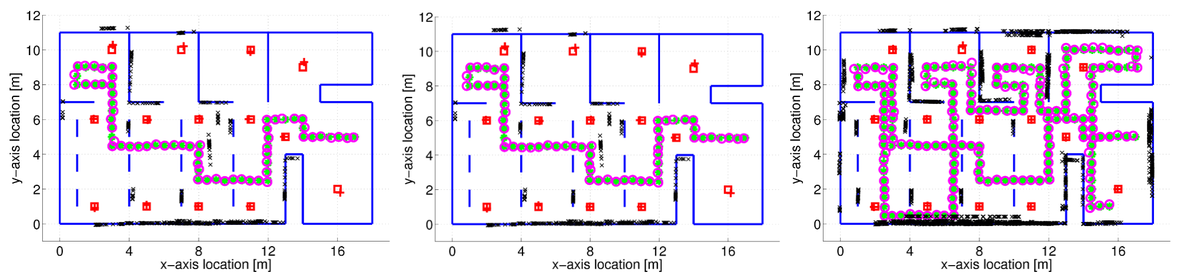


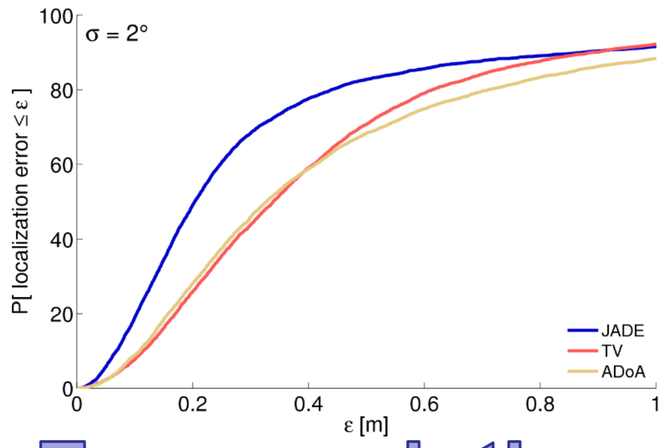
Results

Path reconstruction

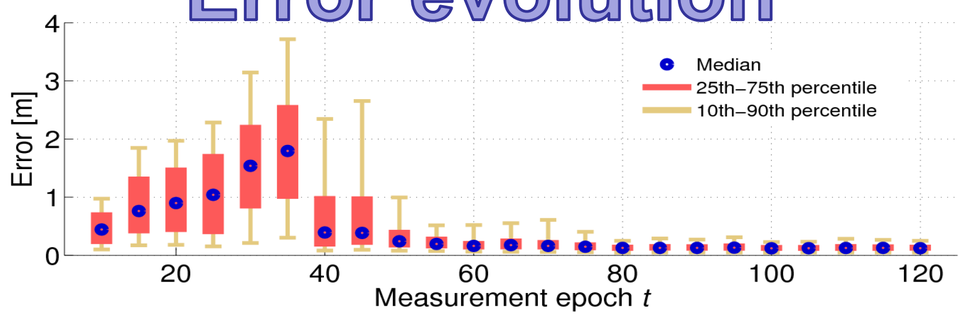


Path reconstruction + SLAM





Error evolution



References

J. Palacios, P. Casari, J. Widmer, "JADE: Zero-Knowledge Device Localization and Environment Mapping for Millimeter Wave Systems", IEEE INFOCOM 2017.

A. Olivier et al., "Lightweight indoor localization for 60-GHz millimeter wave systems", IEEE SECON 2016.