



IPIN 2022

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AND INDOOR NAVIGATION
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Track 7

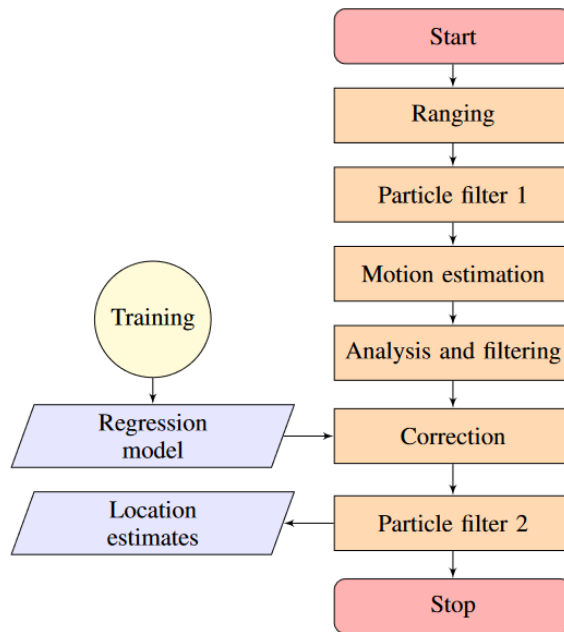
imec-WAVES



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1. Overview



Main components:

- Custom ranging algorithm for the CIR + t0
- Particle filter for initial trajectory estimation
- Regression model for range correction
- Particle filter for final trajectory estimation (w corrected ranges)

Training data:

- Optimisation of ranging algorithm parameters

Trial data:

- Optimisation of particle filter parameters
 - i.e., process noise, measurement noise, likelihood function
- Regression model training



2. Changes wrt last year

Change	Effect on approach	Effect on estimate
EvAAL platform	Limited horizon of measurements	Harder to filter and interpolate
	No retry when things go bad	Can't fine-tune approach or intervene
	Fast run-time required + integrated solution	None
Training data w/o timestamp	Can't be used to train regression model	Possible overfit on limited trial data
Training data on robot	Regression model not applicable to human trail for chosen predictors	Possible overfit on limited trial data
Limited timestamp precision	None	Loss of precision (3 cm)
No environment information	Can't filter out virtual images directly	Inclusion of range overestimations

Conclusion:

- no (easy) re-use of last year's code
- expected loss of precision to our previous approach
- lessons learned from last year not applicable



3. Motion estimation + predictors

Initial Particle Filter:

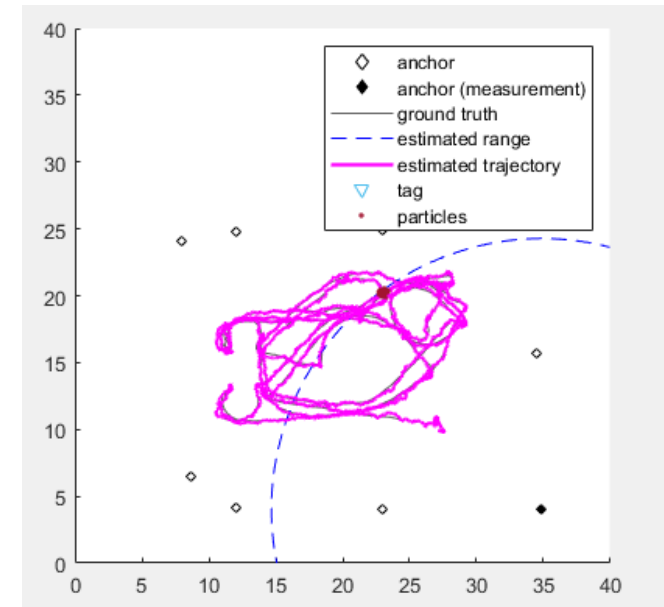
- Corrected only using last range

Calculated predictors:

- X, Y estimate
- Velocity
- Motion vector (direction of motion)
- Incident signal angle wrt tag (AoA)
- Signal angle wrt anchor (AoD)
- “Reliability” of range estimate
- “Signal strength”

Only useful to train on Trial data

- Same measurement platform
- Timestamp data to calculate predictors



→ Corrected range estimates with lower MAE

→ **Final PF only uses the corrected ranges**

On trial (training) data: P75 of 20 cm → P75 of 16 cm

Requested position estimated by propagating final PF

4. Final thoughts

- Comparing to last year's "internal training" results = bad idea (loss of confidence in approach)
 - Though: spurred a lot of trial and error
 - Will retroactively try these out on last year's data as a test
- Online platform makes for a more realistic centralised localisation scenario
- Particle filter approach reaches its limits?
 - More particles = more calculation time
 - More particles \neq better precision
 - Different motion model instead?
 - (EKF still worse)
- Double PF is overkill for live measurements
 - Can re-update last state with corrected ranges
- Per anchor-approaches never worked, needs further investigation

- Big thank you to the organisers!

