RFID Real-Time Localization for Flexible Production Environments (REFlex)

3 academic partners
3 industrial partners
3 years of research

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  - Research question
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- UHF RFID Localization
  - Ranging principle
  - Current research results
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About the Project – Research Question

- **Flexible manufacturing systems** – Routing flexibility
  "determining the next step based on available resources"
  - *Where are the required (hand) tools?*
  - *Which tools and which pre-products are available?*

- **Commissioning / order picking**
  "bringing the correct thing from A to B"
  - *Where is the item?*
  - *Was the correct item taken?*

- **Logistics / inventory**
  "tracking a product from the production process to being sold"
  - *Which items are in the box? Are all items in the box?*
  - *Where are the items?*

→ **RFID for identification/localization**

About the Project – Goals

Chosen technology

UHF RFID (Ultra High Frequency Radio Frequency Identification)

- Read ranges up to 10 m
- Billions of tags already in the market
- Low cost, no battery, read/write operation, optional encryption

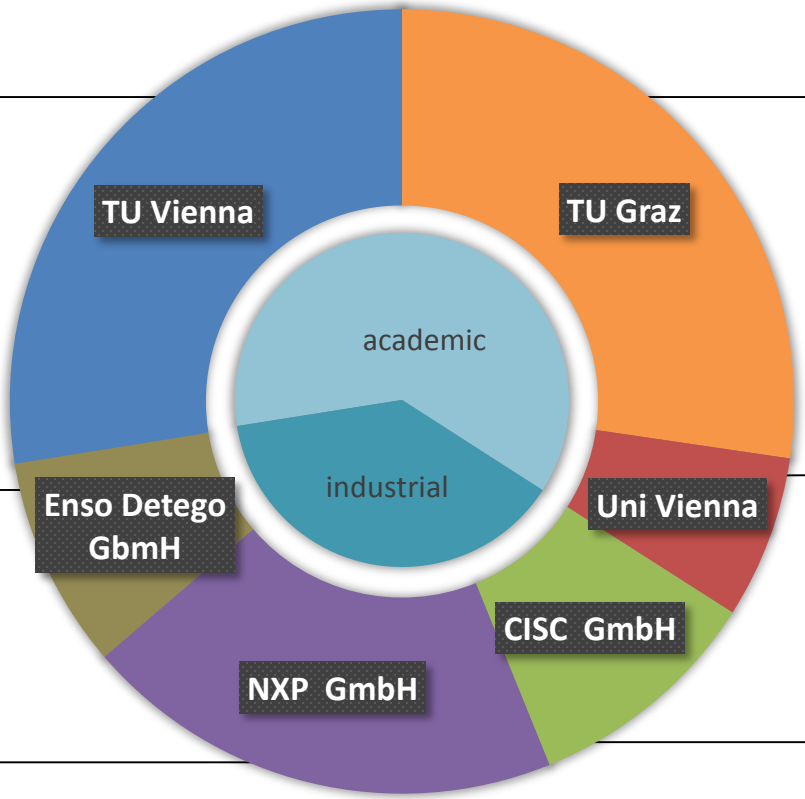
Primary research goal

- Use off-the-shelf RFID tags for ranging/localization in flexible production environments

Sub goals

- Impact onto production processes?
- Ethical and social implications?
- Standardization possible?

Project Consortium



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radio frequency systems, RFID ranging, localization patents

TU Graz

indoor localization, signal processing, performance bounds

ENSO detego

process modeling, industrial requirements

universität wien

ethical and social implications

NXP

custom RFID tag, standardization

CISC semiconductor

standardization, RFID test systems

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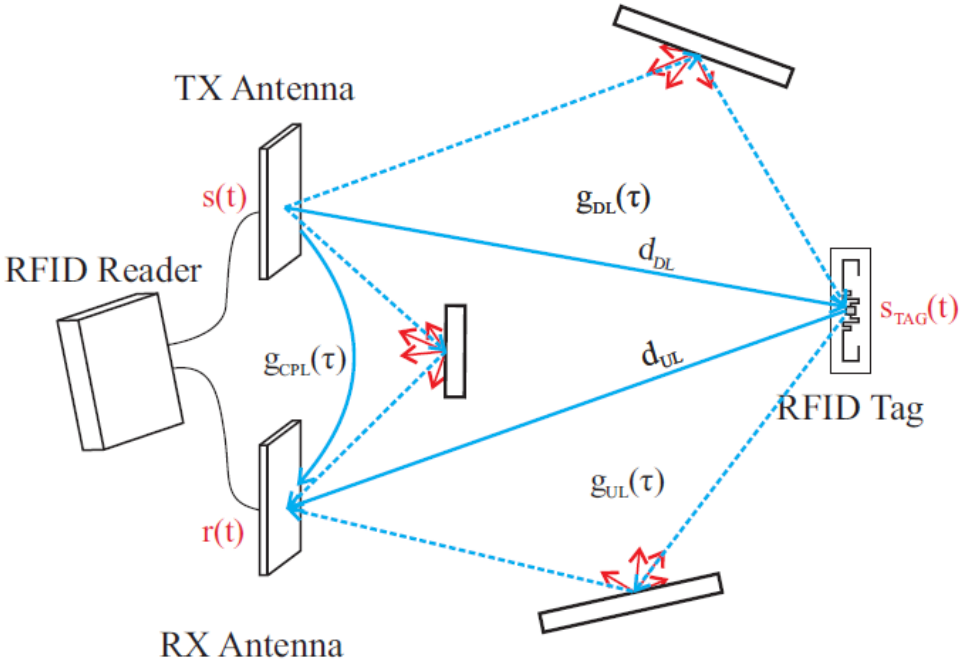
Localization in backscattering systems

- Available localization algorithms are inaccurate
- No precise timing on tag
- Narrowband system
- High self interference

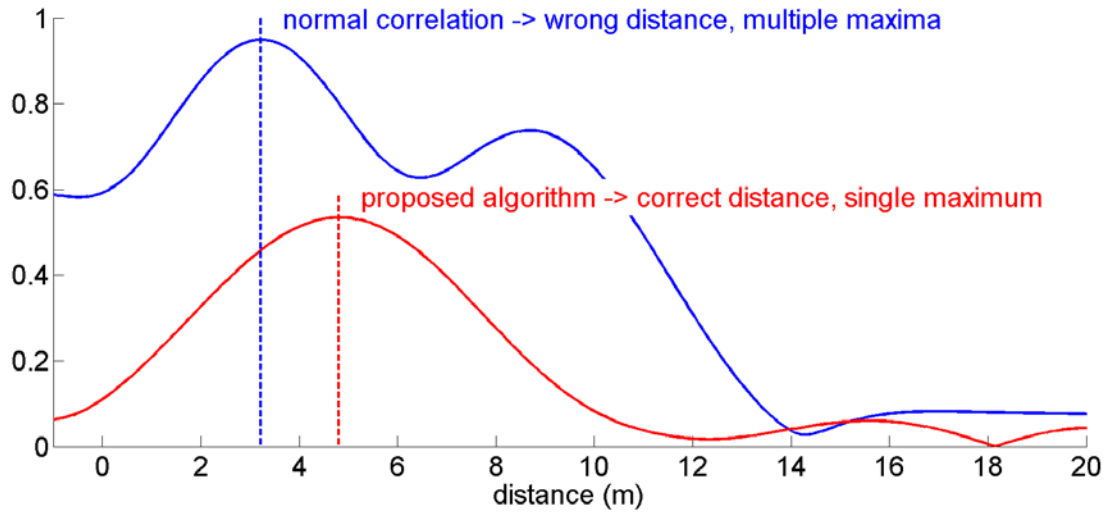


New approach

- Time of Flight (ToF) method
- Seems impossible at a first glance:
  - High bandwidth needed → use of superimposed spread spectrum ranging signal
  - RFID frequency band is narrow → use extremely low power of ranging signal
  - Static echoes must be suppressed → novel algorithm developed and patented

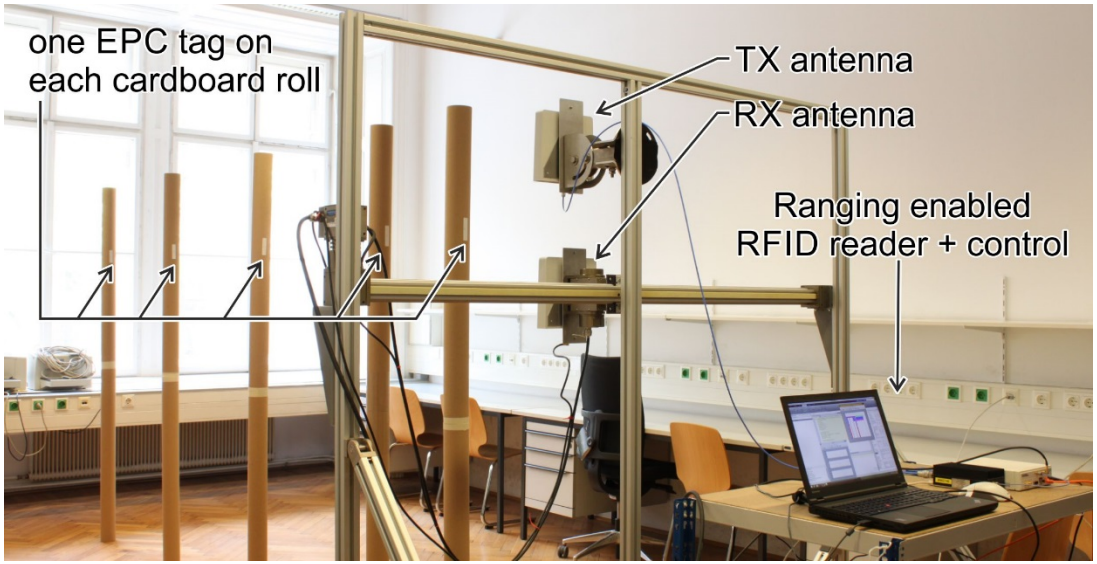
Developed algorithm

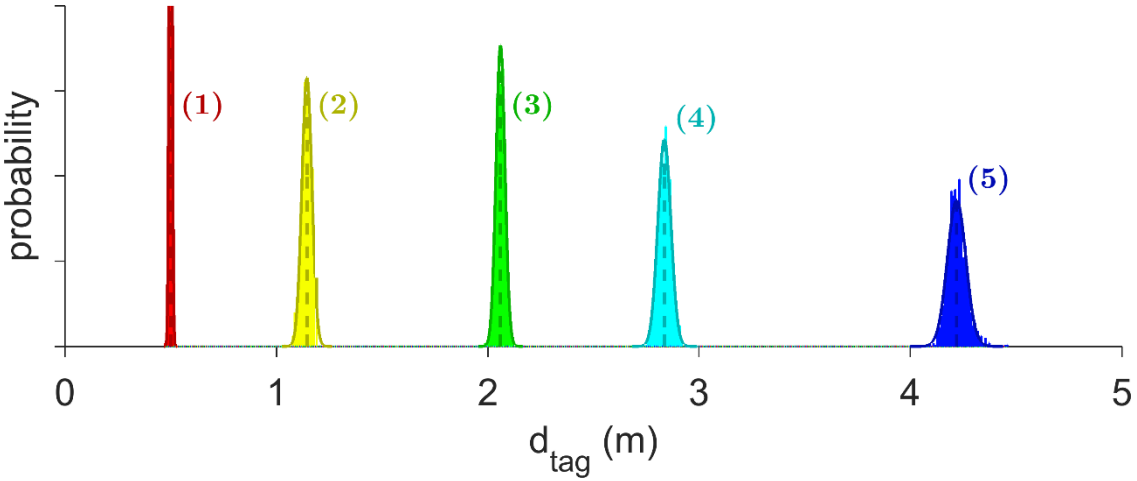
- Direct sequence spread spectrum (DSSS) signal with 25 MChips/s
- DSSS signal is undetected by the tag, does not influence communication
- RFID tag backscatters the DSSS signal as well
- Coherent adding procedure [1] suppresses static echoes and emphasizes the echo from the tag



[1] H. Arthaber, T. Faseth, F. Galler, “Spread-Spectrum Based Ranging of Passive UHF EPC RFID Tags”, IEEE Communications Letters, Vol. 19, No. 10, October 2015, ISSN 1089-7798, pp. 1734–1737

Ranging tests with demonstrator and NXP RFID tags





Tags in distances
0.5m, 1.0m, 2.0m, 3.0m, 4.0m

1000x ranging for each tag:
- max. estimator bias: 22cm
- max. standard dev.: 4.4cm

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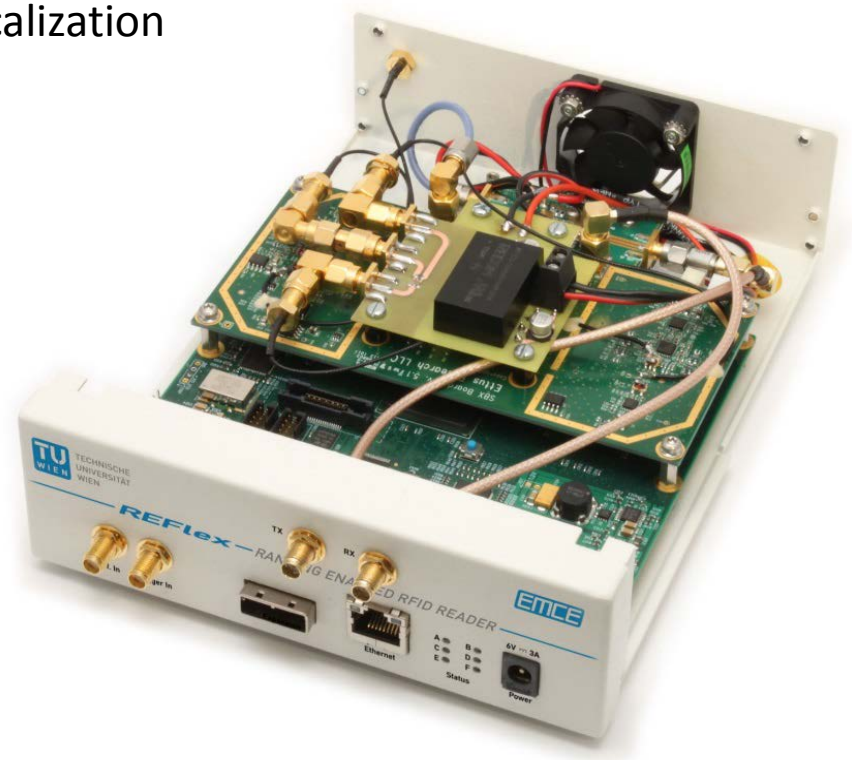
REFlex – RFID Real-Time Localization for Flexible Production Environments

- FFG-Program "IKT der Zukunft, 2nd call"
- 3 universities, 3 industrial partners, 3 years
- Interdisciplinary research on
  - Production process modeling with RFID localization/ranging
  - Development of a new UHF RFID ranging concept
  - Activities in standardization groups and discussion with regulatory bodies
  - Ethical and social implications of RFID localization

Subtask "UHF RFID Localization"

- Novel ranging concept developed
- Compatible with off-the-shelf tags
- Demonstrator shows excellent results
- Performance bounds analyzed



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Thank You For Your Attention!

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