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Indoor Localization for Telemonitoring

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Motivation

- **World report on disability (WRD), 2011: 1 billion has some form of disability**
  - Corresponds to 15% of world's population
  - Major problems faced by disabled people: mobility, everyday activities, health care….
- **Solution**
  - Assisted with technology like GPS for mobility
- **Challenges**
  - In indoor environment, GPS has very weak signal
    - Strong signal attenuation, multiple reflections and diffractions
  - System accuracy in few centimeters
- **State of the art design:**
  - Triangulation, Angle-of-Arrival, Received Signal Strength, Mobile based sensors

Designed Indoor Localization System

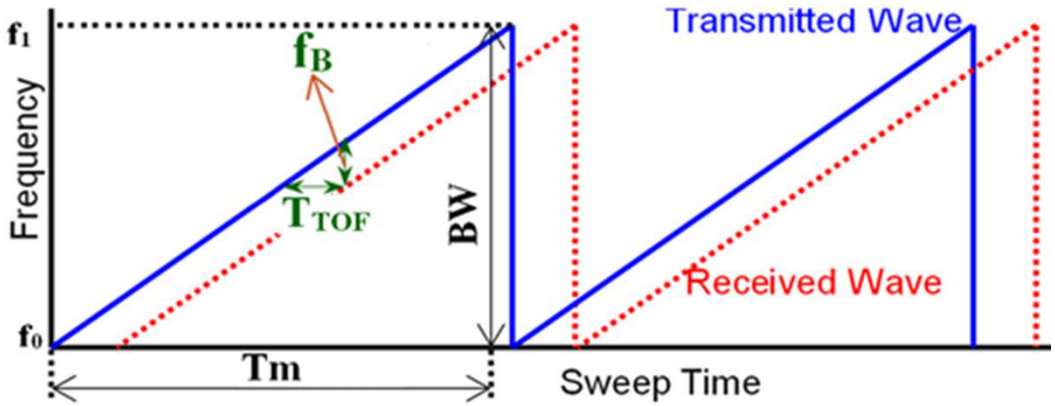
- **Objective**
  - Less complex 3D localization system
  - Accuracy within 10 cm

- **Designed: Multistatic FMCW Radar System**
  - Single anchor
    - 4 Interrogators for 3D positioning
  - Accuracy in few centimeters
    - UWB system (6-8.5 GHz)
  - Circular Polarization Diversity
    - Two dimensional patch antenna design
      - New design for dual circular polarization diversity implementation
      - UWB performance (6-8.5 GHz)
  - Dual-Mixer Time-Difference method for signal processing
  - Successive Mean Difference Approach for cancellation of jitters
  - Active-Tag
    - Frequency transposition for suppressing backscattered signals
  - Solution for filtering-out multipath in Line-of-Sight Condition

Designed Indoor Localization System

- **FMCW radar principle**
  - Radial-Distance (d)

$$d = {(T_{TOF} \times c)}/{2} = {(Tm \times f_B \times c)}/{(2 \times BW)}$$

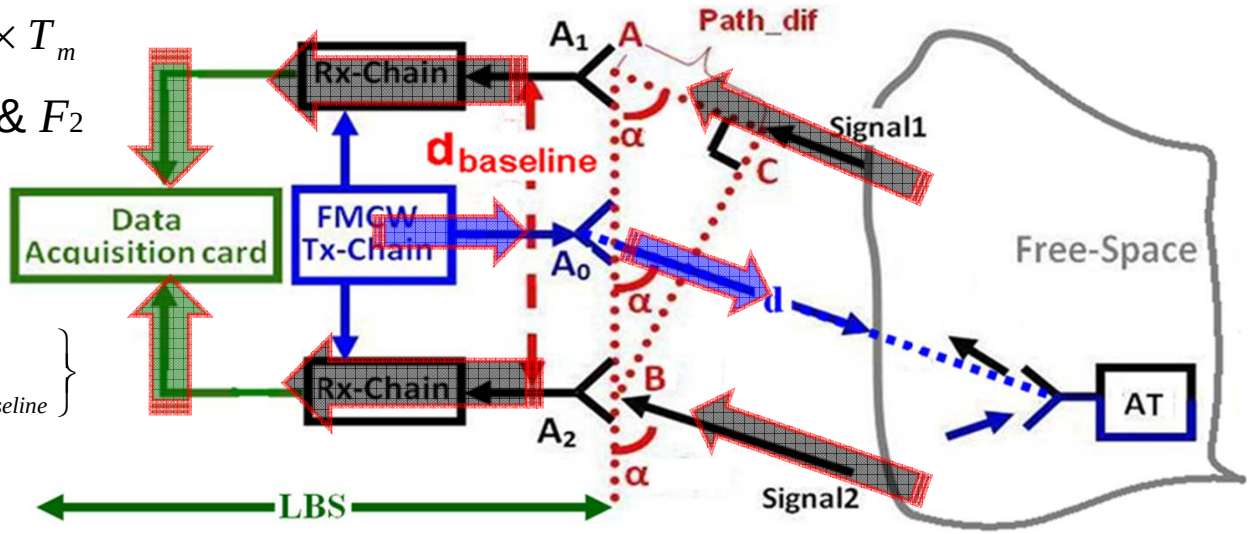


- **Angle-of-Arrival**
  - Phase difference

$$\phi_{12}(T_m) = (F_1 - F_2) \times 2\pi \times T_m$$

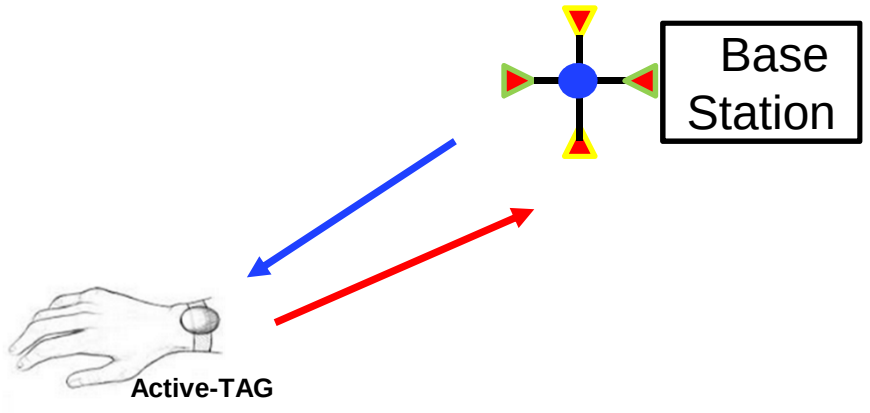
Beat frequencies: F_1 & F_2

$$\alpha = \cos^{-1}\left\{ {\Delta\phi_{12} \times c}/{4\pi \times BW \times d_{baseline}} \right\}$$



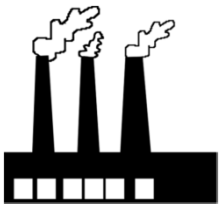
Performances and Perspectives

- **Results:**
  - 3D estimate: RMS error (3.8 cm, 6°, & 4°)
  - 3D localization is achieved using single anchor
  - Measurements performed in a real indoor environment



- **Advantages:**
  - Assistant in Mobility:
    - Accuracy of few centimeters can assist to blind/elderly person as well as physically-challenged
  - Easy installation: Single anchor

- **Perspectives:**
  - Smart Home
  - Assets Management
  - Shopping
    - Contextual Advertisements


Personal Information

- **Working as Researcher at Technicolor, Rennes, France**
  - Research & Innovation Group
    - Wireless Sensing & In-House Localization
  - Applications
    - Monitoring of Elderly persons, Intelligent-Home, …

- **Technical Perspectives:**
  - Design-Integration, Management and Optimization of Positioning System
  - Integration of Mobile based Sensors with Radar Technology
  - Space and Polarization Diversity- Circular and Linear Patch Antenna designs over UWB band
  - Solution for Non-Line-of-Sight scenario through radical innovation-quasistatic fields & classical EM Waves