



# Pervasive Personal Navigation

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MITRE Sponsored Research

# Problem

- **Knowing position of dismounted personnel is essential to a wide variety of missions**
  - **Combat & peace keeping**
  - **Intelligence & covert action**
  - **Emergency response**
- **But GPS reception is not reliable in many places dismount missions are conducted**
  - **Can we provide an alternate means of position determination for those environments?**

# Background

GPS has proven transformational, yet may perform poorly in environments important to dismounts.

## Indoors

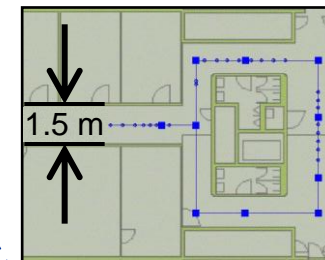


Urban Canyons



Subterranean  
Spaces

*Close Quarters  
Needs Accuracy  
Exceeding GPS*



# Objective



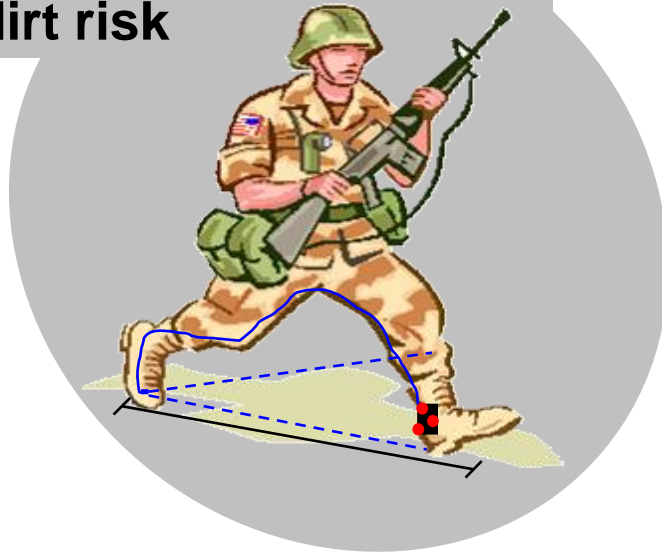
- **Develop solution for autonomous position determination of dismounted personnel in GPS-challenged environments**
  - **Relative position via precision dead reckoning that exploits human walking and running**
  - **Absolute position via high-sensitivity GPS when available**
  
- **This year we are developing a boot-mounted inertial & ultrasonic system, having completed sensor alternatives and system sensitivities studies begun last year.**

- Investigated five sensor concepts for dead-reckoning via precision tracking of feet
  - Optical ranging
  - RF ranging
  - Stereo imaging
  - Inertial
  - Ultrasonic ranging
- Selected two sensors for a fusion approach
  - Toe-mounted tri-axis inertial sensing
  - Sole-mounted ultrasonic foot-to-foot sensing
- Implementing real-time collection system with foot-mounted sensors

# Highlight: Sensor Investigations

## Optical foot-to-foot ranging

Body-worn sensor feasible with moderate design effort, some dirt risk



## RF foot-to-foot ranging

Body-worn sensor feasible with sizeable design effort, but power & accuracy risk



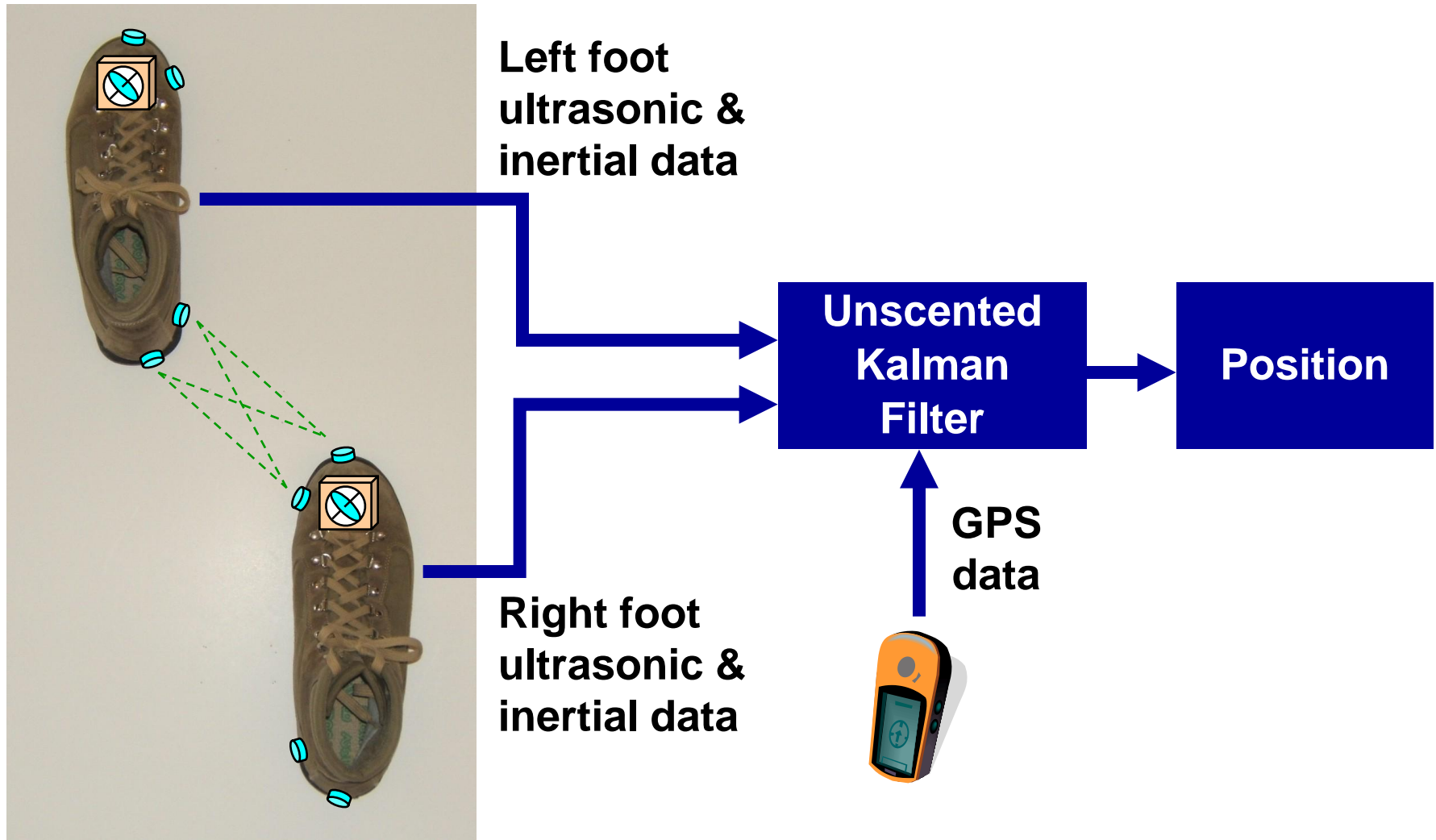
## Stereo foot-to-foot imaging

Body-worn sensor feasible with moderate design effort, but high dust/dirt risk

## Inertial & Ultrasonic

Better choices, see next slide

# Highlight: Selected Approach Uses Inertial & Ultrasonic Sensors



# Impacts



- **High-reliability, high-accuracy positioning will improve dismount situational awareness**
- **Potential users and sample applications**
  - **Homeland security & first responders: map reading without signs, egress navigation, finding downed personnel**
  - **Armed forces: personal blue force tracking**
  - **Intelligence: mapping, path guidance**
- **Pursuing collaborations with universities, DOJ, Army, and contacts from HLS/WPI Indoor Personnel Location workshops**

# Future Plans

- **Calibrate and test combined inertial & ultrasonic system**
  - Real-time data collection
  - Post-processed position determination

