

# **Unmanned Vehicles for the Rest of Us: UxVs for Homeland Security versus Homeland Defense**

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**Special thanks to Jenny Burke, PhD**

**National Science Foundation, SAIC, Florida State Emergency**

**Response Team, Florida Task Force 3**

# Homeland Defense, Security are basically the same, right?

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Hurricane Katrina Bay St. Louis 9/1/06



Hurricane Katrina Biloxi 9/1/06

# 5 Key Points

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- Homeland Security is fundamentally different than Defense on pretty much any dimension: motivation, worker competencies, ...
- Homeland security UxVs is more about “remote presence” right now while HD is about “taskable agents”
- UxVs aren’t competent for either category
- Therefore, multiple people are needed to create competence, leading to computer-mediated team processes as an important research top
- Heterogeneous robot agents make team processes even harder

# Why Should You Believe me?

**Institute for Safety, Security, Rescue Technology (iSSRT)**  
*Systems: robots, sensors, networks, decision sciences, training*

Colleges of Arts & Sciences, Engineering, Marine Sciences, Public Health

**NSF industry consortium**

*With Minnesota  
(CMU, Penn)*

*Members include  
Honeywell, Lockheed-  
Martin, Radiance,  
Remotec, SAIC,  
SOCOM, ARL, ...*

**Basic Research**

*NSF, DARPA,  
ONR, DOE*

**Center for Robot-  
Assisted Search &  
Rescue (CRASAR)**

- Adapt commercially available or DoD equipment
- New technology with TRL 7



# Why Should You Believe Me?

- **Academic credentials**

- PhD Georgia Tech 92, Rockwell Doctoral Fellow, minor in computer integrated manufacturing
- 100+ publications, including #1 textbook, research awards
- IEEE Robotics and Automation Society Technical Committee on Safety, Security, Rescue Robots
- DISCOVER Top 100 Science Stories of 2002, TIME Magazine Innovator in Artificial Intelligence (June 14, 2004)

- **Significant Industry, Public Sector Experience**

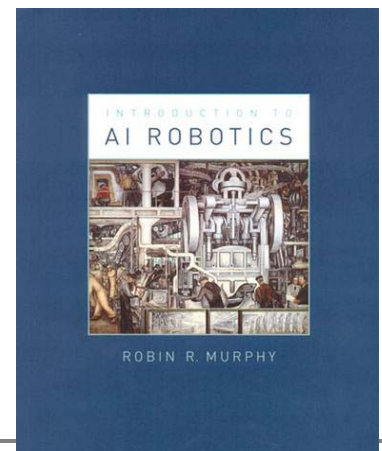
- Director and co-founder NSF industry/university cooperative research center
- Executive Board International Emergency Technical Rescue Institute (IETRI) and NIUSR, Technical Search Specialist FLTF3
- World Trade Center Response, Hurricane Charley, LaConchita Mudslides

- **Extensive Government Service**

- USMC Chemical Biological Incident Response Force Technical Advisory Board, Defense Science Study Group, USAF Scientific Advisory Board, Army Science Board, USD OS&T Air Platform TARA



TIME June 14, 2004 Edition



# Rescue UGVs, UAVs, USVs

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- WTC (2001)
  - **UGVs**
- La Conchita Mudslides (2005)
  - **UGVs**
- Katrina response [2005]
  - Hancock County, MS; **fixed and rotary wing MAVs**
  - Biloxi; **UGV**;
  - New Orleans; **fixed wing UAV**
- Rita [2005]
  - Florida Keys; **fixed wing UAVs**
  - East Texas; **fixed wing UAVs**
- Wilma [2005]
  - Marco Island; **rotary wing UAVs, USV**
- Katrina recovery [2005]
  - Biloxi/Gulfport; **rotary wing MAVs**
- Sago Mine Disaster [2006]
  - **UGV**

# CRASAR: 5 out the 7 Deployments

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  - *Hancock County, MS; fixed and rotary wing MAVs*
  - *Biloxi; UGV;*
  - *New Orleans; fixed wing UAV*
- **Rita [2005]**
  - *Florida Keys; fixed wing UAVs*
  - *East Texas; fixed wing UAVs*
- **Wilma [2005]**
  - *rotary wing UAVs, USV*
- **Katrina recovery [2005]**
  - *rotary wing MAVs*
- **Sago Mine Disaster [2006]**
  - **UGV**

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# Homeland Defense and Homeland Security

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Notification



Examples

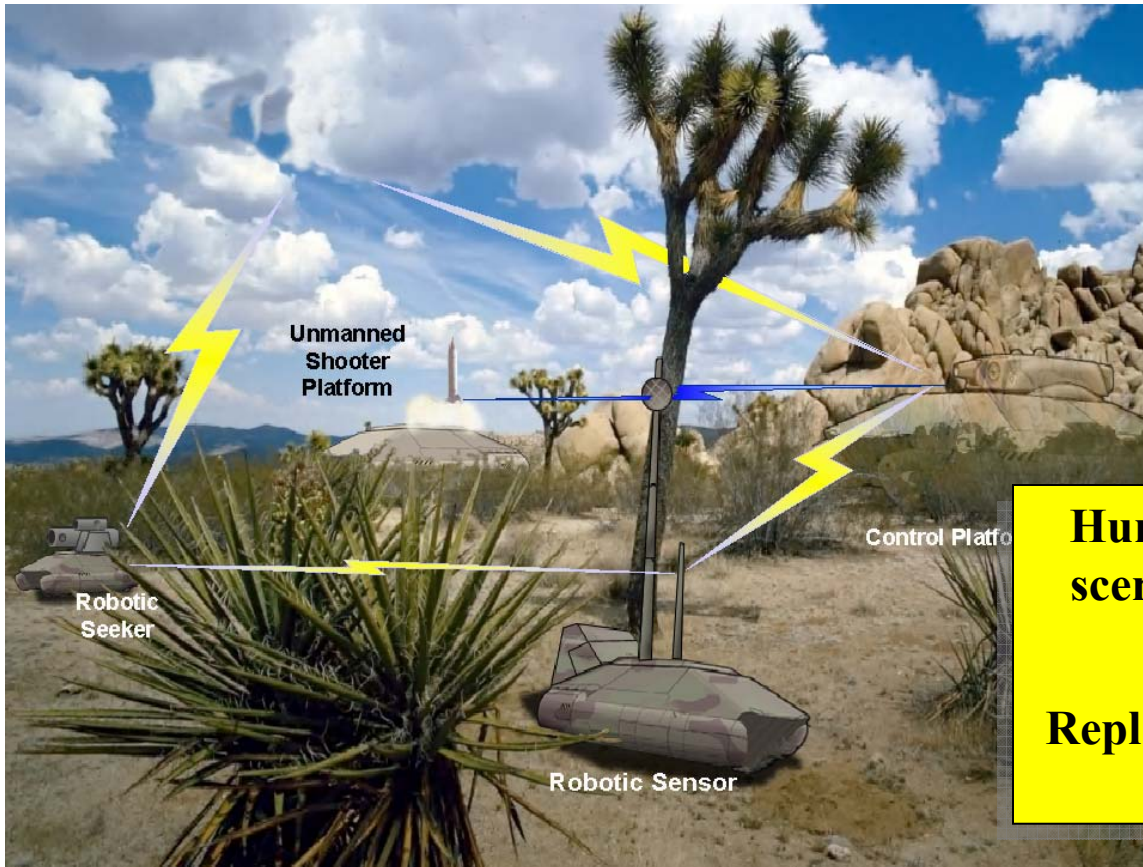
- Homeland Security
  - Civilian, DHS purview specified by the National Strategy for Homeland Security
  - Technologies for Prevention, preparedness, response, recovery cycle
  - ***Law enforcement, fire rescue, medical plus EPA and >28 agencies, NGOs***

# UxV Differences Between Homeland Defense and Security

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- Motivation: 3Ds
- Motivation: Better than bio

# Motivation: Homeland Defense



The **3D** tasks:

- **D**irty
- **D**angerous
- **D**ull

**Humans very far from scene (& trying to stay that way)**

**Replacing humans so the task is known**

# Motivation: Homeland Security

## Better than Bio

- Do tasks that living things can't
  - voids smaller than person could enter
  - voids
- Do tasks that humans do well
  - Ex. NBC Response
  - Lose 1/2 cognitive attention with each level of protection
    - Level A=12.5% of normal ability

**Humans near the scene (& trying to get into)**

**Doing novel tasks that may not have a good concept of operations for**



# UxV Differences Between Homeland Defense and Security

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- Defense: 3Ds
- Constant training, tools used daily
- Highly centralized C2 with trained personnel
- Environment: human-habitable, human scale
- Security: Better than bio
- Infrequent training, tools used as an exception
  - Ex. Special operations, plus lawsuits
- Highly distributed ad hoc personnel, with no communication
  - Ignore NIMS, NRS
- Deconstructed or odd viewpoints

# 5 Key Points

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# UxV Differences Between Homeland Defense and Security

- Defense: 3Ds
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## TASKABLE AGENT

- Security: Better than bio
- Infrequent training, tools used as an exception
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- Deconstructed

## REMOTE PRESENCE

# Civilian Information Sources During Extraordinary Events

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## *Human physically-situated:*

*People carry these and provide on-the-spot conversion to information, knowledge*

## *Device physically-situated:*

*Many of these devices are remote from humans, often serve as **presence**/surrogate for human*

## **Real-Time**

- Traditional: *HUMINT, Hazmat, weather, IR, canines*
- “smart” consumer devices: *PDA's, cellphones, camcorders, wireless-enabled\**
- DoD/DoE/NASA devices: *Man-packable/portable robots, sensors, night vision, GPR*

# Characteristics of RPITs

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- 1. Very difficult to build and maintain real-time situation awareness (SA) because mediated presence**



Robot plus OCU WTC2 9/12/01



WTC2 9/18/01

# Characteristics of RPIT

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## 2. Opportunistic, unplanned, expect-the-unexpected phenomena- hard to automate like ATR



WTC Tower 2 9/18/01

# Characteristics of RPITs

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## 3. Are an active resource, not passive, for multiple “consumers”

- *Contention for control*
  - *Ex. Structural specialists vs. medical specialists*
- *Training on device may not be best use of specialists*
- *Creates “tunnel-vision” where consumer is distracted from the mission*



WTC

# Characteristics of RPITs

## 4. Pose significant infrastructure challenges, especially due to need for video, multiple consumers

- *Video takes up available bandwidth and we like to use multiple modalities*
- *Push vs. pull*
- *Distributed team performance is much less than co-located teams- do better if **shared visual presence** (Burke 06)*
- *Often need a facilitator*



ShadowBowl 2003

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# Physical Competence

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CBRIF 11/04

# Cognitive Competence

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- Previous examples of problems
- Fixed-wing crash at Katrina



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# Humans as Cognitive Augmentation for Robots

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- Different team responsibilities leads to different SA
- But... Op tempo of under 20 minutes; high consequence of failure/being distracted may impair team discussion, planning as per *Park et.al. 05*
- Some activities are physically situated and some are computer-mediated and this may introduce additional problems

# Return to Katrina

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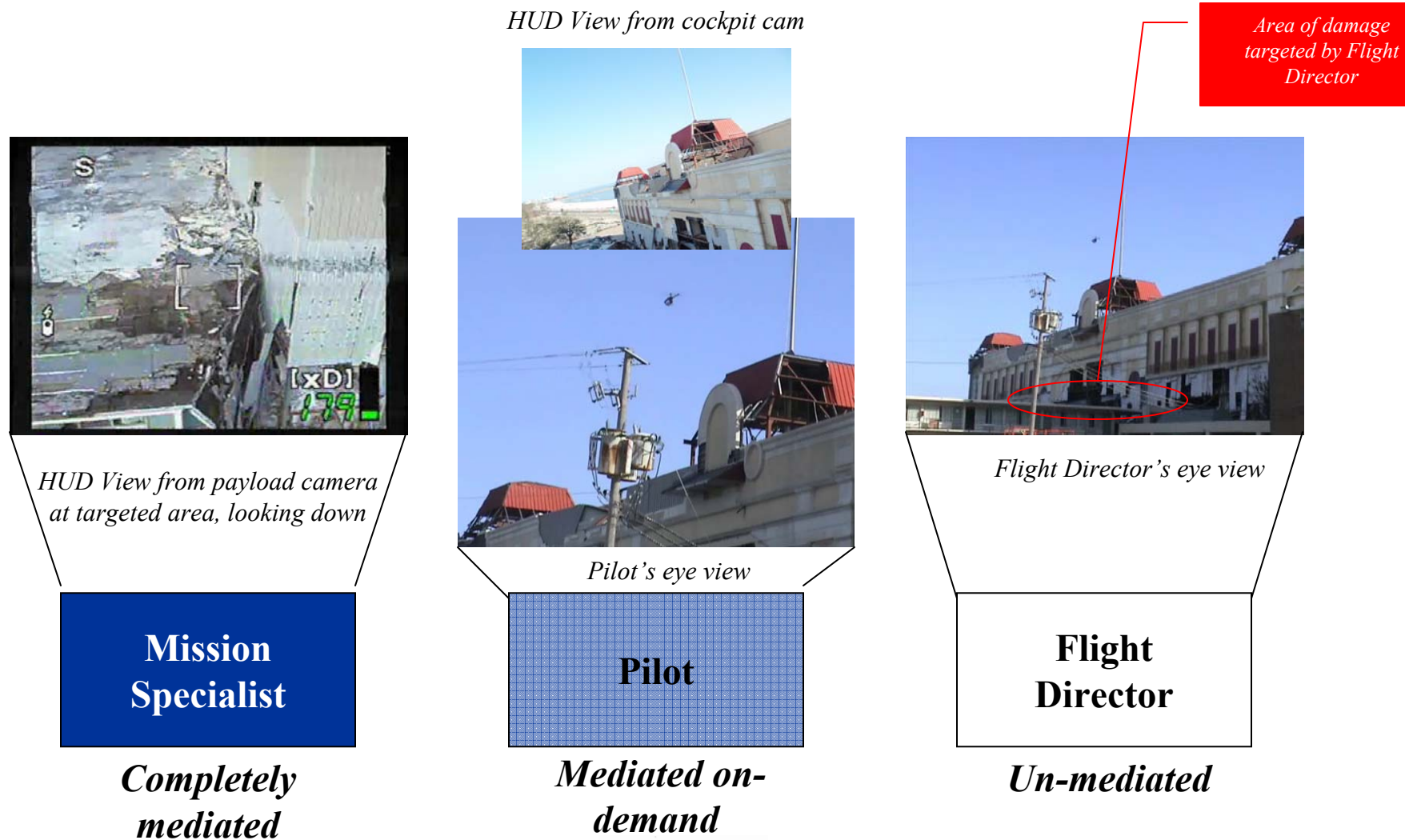


# 3 Emergent Roles

*(similarity to Cooke et.al. in number & convergence time)*

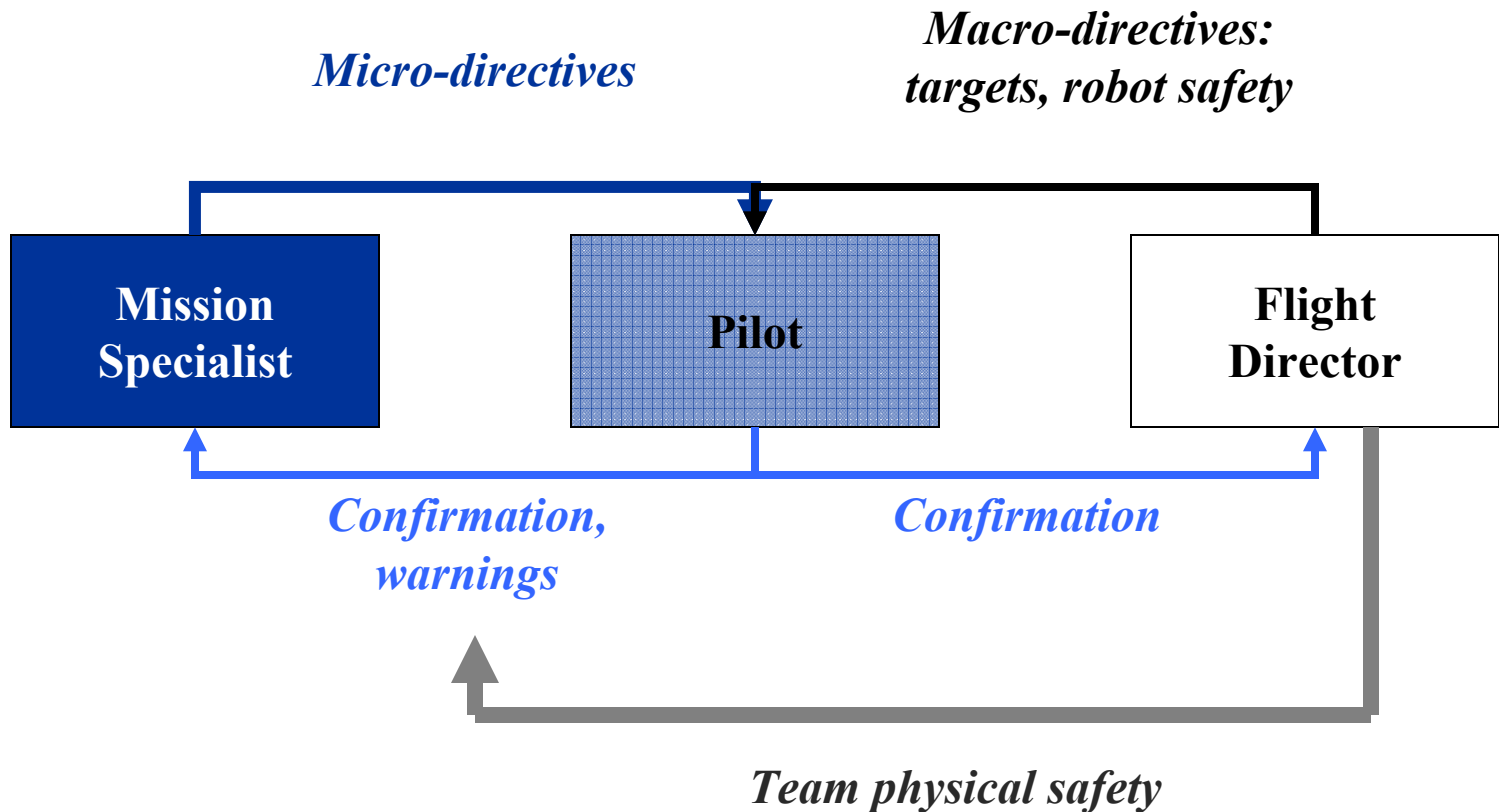


# 3 Roles: Mediated Processes



# 3 Roles: Communications

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# Hurricane Wilma: MAV and USV

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# Wrap up: Some Questions

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- Homeland Security is fundamentally different than Defense ...
  - How to train? Conduct quick-time CWA? Manage user expectations? How to match conops with worker competencies?
- “remote presence” right now while HD is about “taskable agents”
  - How to handle time lags, displays, ...? How to overcome visual capture, backseat driving?
- UxVs aren’t competent
  - What’s really needed for augmentation? Handling failures?
- Partially computer-mediated team processes
  - How to support and sustain team performance? How to handle lack of video game viewpoints? What about physically situated operators?
- Heterogeneous robot agents
  - Will it add more people? What viewpoints to share? Can displays, workers really be generic?

# Seeking Professional Help!

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**All data sets available upon request**

**Lots of opportunities for field work, insertion through our industry center and joint grants**

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