CyberATV

Mobile Distributed Reconnaissance and Surveillance

In the CyberScout project, we are developing mobile robotic technologies that will extend the sphere of awareness and mobility of small military units while exploring issues of command and control, task decomposition, multi-agent collaboration, efficient perception algorithms, and sensor fusion. As one of the multiple platforms within CyberScout, we have developed two Unmanned Ground Vehicles (UGVs) (named Lewis and Clark, after the famous explorers) by retrofitting two Polaris all-terrain vehicles (ATVs), automating their throttle, steering, braking, and gearing functions and giving them computation for control, navigation, sensing, and communication.

Research Thrusts

- **Vehicular control**
  - Velocity control of an internal combustion engine
  - Nonlinear (hysteretic) steering model for accurate locomotion and pointing
- **Perception**
  - Visual surveillance on a mobile platform
  - Geolocation and tracking of people and vehicles
  - Navigation using multiple visual cues
- **Distributed Agent-Based Collaboration**
  - Task decomposition
  - Collaborative classification, geolocation, and visual tracking
  - Autonomous convoying

Autonomous Convoying

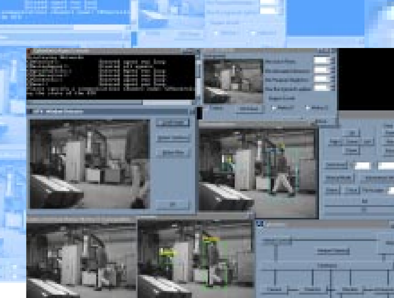
Approach

- **Agents**
  - Agent-based control
  - Agent-based active perception
  - Distributed agent-based collaboration
- **Cyber*ARIES***
  - Provides the distributed agent-based backbone
  - Focuses on emergent collaboration in an ***A**utonomous **R**econnaissance and **I**ntelligent **E**xploration **S**ystem*
  - Provides scalability, robust fault-tolerance and graceful degradation as nodes in a sensor network fail
- **Neural Networks**
  - Computational efficiency in detection and classification
  - Event learning and novel HCI for tasking and teaching

Remote Operation with Wearable Computer

Communication

- Among mobile platforms and users: 915 MHz DEC Roamabout wireless Ethernet
- Between mobility and perception processors: serial communications
- 915 MHz spread-spectrum radio modem to receive GPS differential corrections



Personnel/Vehicle Detection and Recognition

Computing

- PC/104 for mobility
- Multiple 350MHz PentiumII processors for perception

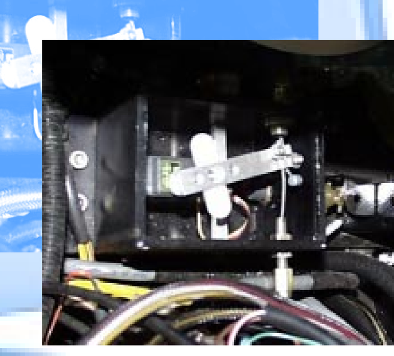
Sensors

- NovAtel 20-cm resolution GPS using differential base station
- Five cameras with pan-and-tilt
  - Two for navigation
  - Three for perception

Generator and Hydraulics

Actuation

- Hydraulic system to control steering, braking and gearing
- R/C servo motor to control the throttle
- 2.5 kW generator for auxiliary power



Throttle Actuation

Remote Control Devices

- Radio control joystick
- Laptop PC via wireless Ethernet
- Wearable computer via wireless Ethernet

Brake Actuator

People

- ***Principal Investigators***
  John Dolan, Ph.D.
  John Hampshire, Ph.D.
  Pradeep Khosla, Ph.D.
- ***Faculty/Research Staff***
  Ashitey Trebi-Ollennu, Ph.D.
  Al Grupe
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- ***Undergraduate Students***
  Brian Boylston
- ***Graduate Students***
  Kiran Bhat
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  Benjamin R Pugliese
  Mahesh Saptharishi
  Marios Savvides
  Alvaro Soto
- ***Consultants***
  K^2T (Actuation)
  Abby Beck (Composites)
  Ryan Sullivan (Composites)
  Carl Worst (Paint)

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