Evaluation of Man-Portable Robots for Urban Missions

Henrik I. Christensen
KUKA Chair of Robotics - hic@cc.gatech.edu

Center for Autonomous Systems
Royal Institute of Technology
Stockholm, Sweden

Robotics and Intelligent Machines
Georgia Institute of Technology
Atlanta, Georgia

Acknowledgement

- Joint effort with Major Carl Lundberg, I1
- Direct collaboration with the Royal Swedish Regiment (I1)
  - Includes the Swedish international infantry unit
- Sponsored by the Swedish Defense Materials Administration

Urban Assistance to Soldiers

- Urban intervention is stressful!
- Urban missions typically carries the most casualties
- There are well defined strategies for urban operations
- Clear that robots may be of significant value for such operations

- EU Battle Group 08? Should robots be included?

Task Motivation

- Entry into buildings is stressful
- A need to generate situation awareness

- Detection of key entities in an area

- Early reconnaissance

Objective of study

- A number of events has indicated the value of use of robots
- What are the challenges?
- Where can robots be used effectively?
- What are the main limitations?

Focus of study

- Embedding of man-portable robots into a group of soldiers for urban search and clearance
- Use of PackBot Scout systems from iRobot
- Changes in user interface

User Interfaces

Interface example

What are user issues?

- How does the strategy change with a robot?
- What are the requirements for communication?
- Is the cost / benefit acceptable?

Doctrine is well defined

BILAGA 3

Bild 3. Observation runt gathörn och länder

- Rulla snabbt över muren med kroppen tryckt mot marktrönet.

Bild 5. Passage över länder, mur m m

- Observation före framryckning göes från skuggsidan.
- Bestäm nästa skyddsställning.

Bild 4. Uppträdande i dörröppning

- Framryckningen göes som en snabb rusch, kroppen något hopkrupen.

Bild 6. Passage över gata vid byte av framryckningsriktning

How well do robots perform?

- Tested wit… Royal Swedish Regiment (~200 soldiers that are specialists in Urban interventions) over a periods of 12 months (2005-06, 2006-07, 2007-08)
  in total close to 600 soldiers

Robotics@GT & Intelligent Machines

Missions

- Mapping of environments

- Search for objects

- Inspection

Evaluation Strategy

- Start
  - Questionnaire to all soldiers in regiment
    - Is this useful, applications, usability, limitations, ... 34 questions in total
  - Training in use (“operator school”)
- Through-out evaluation period
  - Revision of strategy/doctrine
- By completion
  - De-brief of all and new questionnaire

Analysis of Strategy

- Revision of group strategy
  - A robot is not just another sensor
- Strategy is highly task dependent
  - Clearance of a house is different from search, inspection, ...
- Careful analysis took 3+ iterations
- The problem is highly interdisciplinary!
  - Anthropology, CS, Human factors, ...
- The gain can be substantial

Lessons

- At start 30% thought robot would be useful
- By end 100% considered robot invaluable
- The strategy for a group must be revised
  - Adding a robot is not a trivial problem
- Different actors have different requirements
- Interfaces must be carefully designed
- An operator guard is needed - s/he is easily “lost” / cognitively overloaded!

HCI Lessons

- Situation awareness requires mapping
- Pure tele-operation challenges perception
- Simple things such as “snap” makes sense
- Semi-autonomy essential to relieve operator
- End user involvement is crucial
  - Do not leave it to engineers!
- Our children have better HW than our soldiers

Overall Lessons

- Early end-user involvement is crucial
- Long-term studies are required to generate credible results
- Essential to consider end-to-end process
- Careful evaluation is time consuming

Summary

- Small UGV systems can offer effective support
- Integration with unit must be carefully considered
- The design of user interfaces is not really there
- Long term evaluation is essential to understand results
- There are many issues to consider
  - Operations, Training, Logistics, …