CHIST-ERA Projects Seminar

Topic AMCE – Adaptive Machines in Complex Environments

Paris, April 11-12, 2018
Presentation of topic

- **Autonomy**
  - AdaLab, COACHES, ALOOF

- **Complex environments**
  - AdaLab, COACHES, ALOOF

- **Project overlap**

- **Major outcomes and achievements**
  - AdaLab, COACHES, ALOOF

- **Remaining challenges and needs**

- **Potential sources of further funding**
AdaLab: Adaptive Automated Scientific Laboratory
- http://www.chistera.eu/projects/adalab
- Brunel University, University of Manchester, University Paris-Nord, University of Evry-Val-d-Essonne, KU Leuven

COACHES: Cooperative Autonomous Robots in Complex and Humans Environments
- http://www.chistera.eu/projects/coaches
- University of Caen Basse-Normandie, Sapienza University of Rome, Vrije Universiteit Brussel, Sabanci Universitesi

ALOOF: Autonomous Learning of the Meaning of Objects
- http://project.inria.fr/alooof
- Sapienza University of Rome, University of Birmingham, TU Wien, Inria
Computer systems capable of originating their own experiments, physically executing them, interpreting the results, and then repeating the cycle.
Autonomy - COACHES

- Monitoring the environments
- Interacting with people
- Distributed planning for
  - Accomplishing tasks: assistance, escort and support security units
- Robust navigation in crowded environments
How does a robot know it doesn’t know?

How to extract from the Web information useful for a robot, from a robot query?

Let’s see on the Web..

Ok, now I know what to do with it

..cannoli..pastry..
..ricotta filled.. goes in the fridge..

How to use such information to build a semantic object map?

How to bridge between the Web representations and the own robot representation?
Environment - AdaLab
Environment - ALOOF
Knowledge representation
- AdaLAB: set of ontologies that describes meaningful components of the lab environment + logical models of the application domain
- COACHES: logical models describing the components of the environment + human behaviour
- ALOOF: semantic database of objects relations (e.g. is a, used for) + 2D and 3D visual features extracted from images

Probabilistic reasoning about an uncertain environment
- AdaLAB: Bayesian reasoning over biological networks
- COACHES: Bayesian and particle filters for human behaviour
- ALOOF: Probabilistic reasoning scheme on object relations + Deep Learning for object recognition
Project Overlap

- Human computer interactions
  - AdaLAB: dedicated communication mechanism
  - COACHES: multimodal interface and language for interaction templates
  - ALOOF: no direct human interaction apart from the assignment of an initial task

- Planning – partial information, constraints
  - AdaLAB: experiment planning
  - COACHES: distributed markov decision process for task sharing and planning
  - ALOOF: detection of knowledge gaps, comparing existing knowledge with new situations
Major outcomes and achievements - AdaLab

- Integrated Autonomous System for Scientific Research
- Three novel machine learning systems for generating scientific hypotheses.
- Two novel AI systems for deciding on scientific experiments.
- Significantly improved biological models about cancer and ageing.
Major outcomes and achievements - COACHES

- Distributed decision making and reasoning techniques for joint and collaborative activities
- Multi-modal human-robot interaction
- Robust Multi-Robot systems for public spaces (transfer from malls to hospitals)
- Long-term autonomy
Major outcomes and achievements - ALOOF

- Automatic creation of a perceptual and semantic knowledge base for robots on demand, from the Web

- **Databases**
  - OSD Object Segmentation Database
  - ARID Autonomous Robot Indoor Dataset (ICRA 2018)
  - DEKO Default Knowledge of Objects, type, room, relations, action and affordances

- **Tools**
  - MORSE robot simulation: generation of the spatio-temporal dynamics of everyday objects
  - Software library for semantic segmentation, ROS
  - View planning, crowd-based labelling and unknown object inference: integrated in STRANDS project
  - KNEWS, a pipeline of NLP that outputs frame-based knowledge
Remaining challenges and needs / Roadmap

- **Planning – partial information, constraints**
  - Representation of default knowledge and common sense knowledge
  - Unplanned and conflicting situation
  - Collaborative, multi-agent planning with partial information

- **Human-robot knowledge building and sharing**
  - Collaborative Knowledge discovery
  - Fusion of heterogeneous sources of information
  - Adjustable and Adaptive autonomy (under certified limits)

- **Understanding and Interpretation of information**
  - Scene understanding: relate object to environment and people behaviour
  - Interpretation of models, making sense of data
  - Object functions, object-to-object relations, object-parts-relations, articulated and deformable objects
Potential sources of further funding

- Identify potential sources of further research funding
  - CHIST-ERA
  - Industry
  - H2020 (identify calls)
  - Others
Questions ?