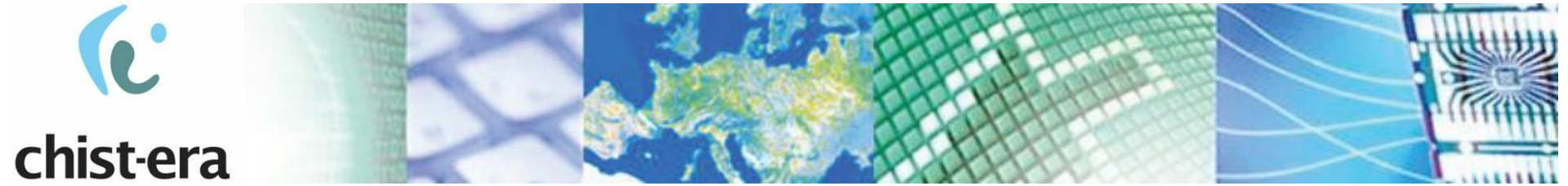


CHIST-ERA Projects Seminar
Topic AMCE – Adaptive Machines in Complex Environments

Paris, April 11-12, 2018

FUNDING OPPORTUNITIES from the FUTURE & EMERGING TECHNOLOGIES scheme

Presentation of topic

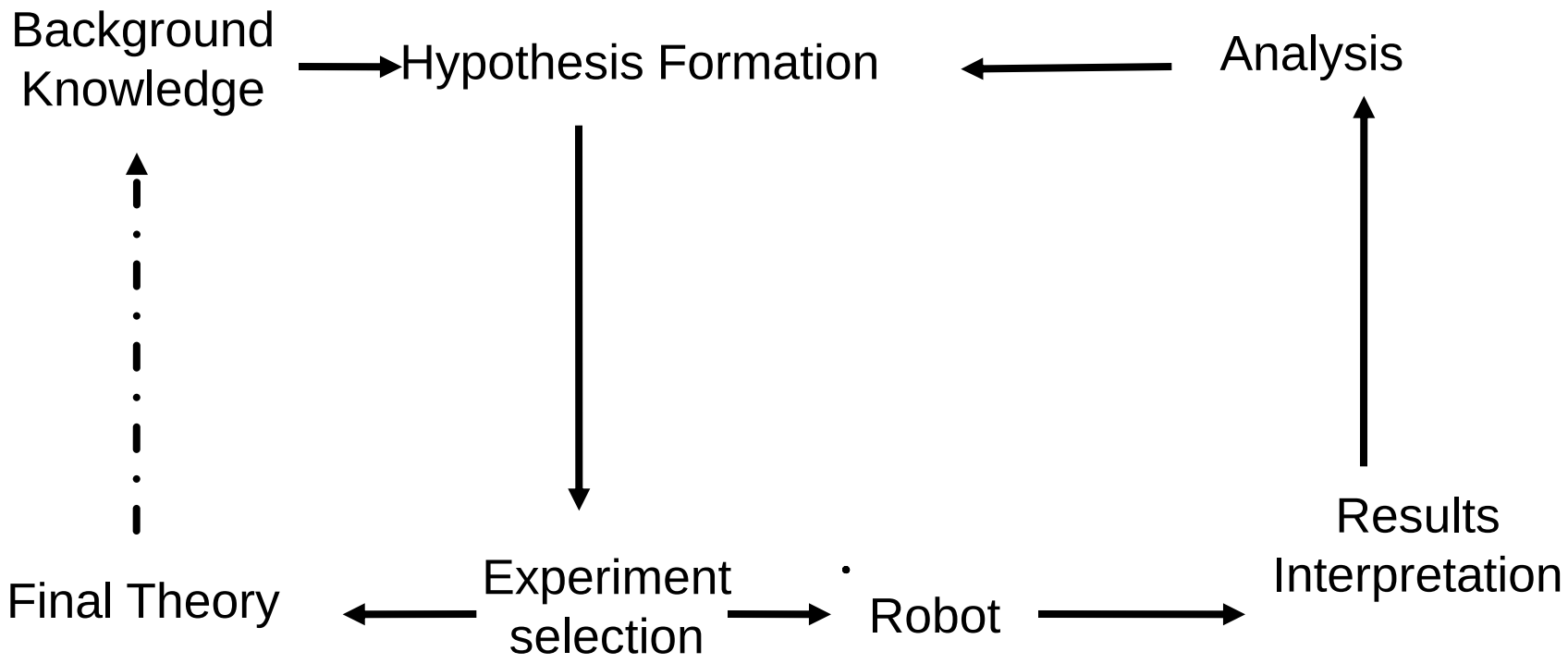
- **Autonomy**
  - AdaLab, COACHES, ALOOF
- **Complex environments**
  - AdaLab, COACHES, ALOOF
- **Project overlap**
- **Major outcomes and achievements**
  - AdaLab, COACHES, ALOOF
- **Remaining challenges and needs**
- **Potential sources of further funding**

Adaptive Machines in Complex Environments – AMCE

- **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/aloof
  - Sapienza University of Rome, University of Birmingham, TU Wien, Inria

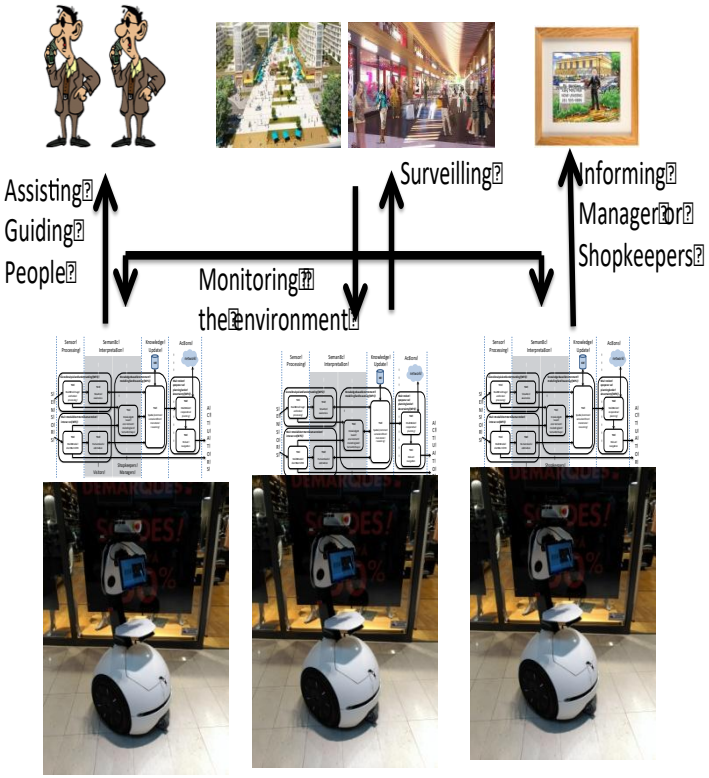
Autonomy - AdaLab

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**



SERVICES

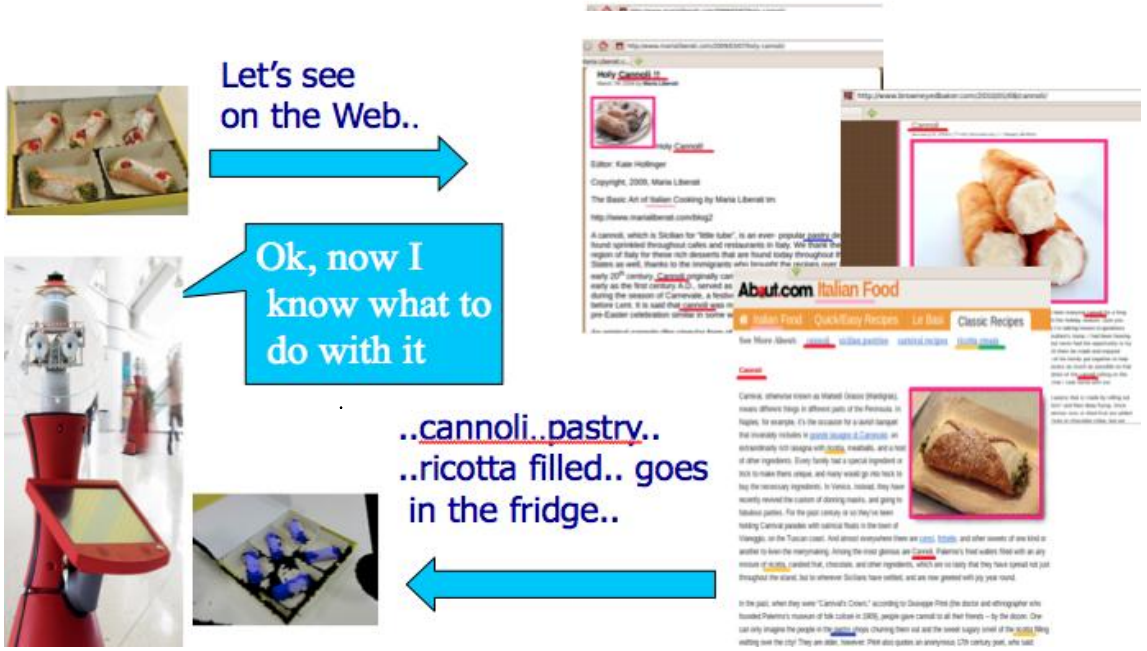
SOFTWARE

ROBOTS

Autonomy - ALOOF

How does a robot know it doesn't know?

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



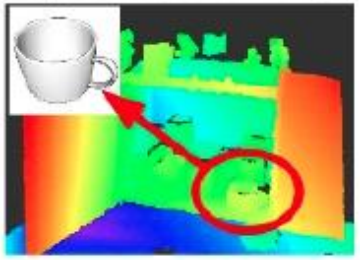
How to use such information to build a semantic object map?

How to bridge between the Web representations and the own robot representation?

Environment - AdaLab

Environment - COACHES

Environment - ALOOF



Project Overlap

❖Knowledge representation

- AdaLAB: set of ontologies that describes meningful 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
- http://strands.readthedocs.io/en/latest/index.html
- 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

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Questions ?