RHUM
Robots in Human Environments

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Context

• Thanks to the recent technological advances, robots appear in our daily lives

• Robotics is central to numerous socio-economic challenges

  – Europe
    ❖ CA-RoboCom one of the 6 preselected H2020 FET flagships;
    ❖ FP7 ICT work program: Challenge 2: Cognitive Systems & Robotics.

  – France Robots Initiatives
    ❖ Robolution Capital (80M€);
    ❖ Innorobo.

  – Rhône-Alps
    ❖ Coboteam (ARDI) & Plan Robotique Régional.

  – Grenoble
    ❖ Numerous research teams in several PERSYVAL labs are involved in numerous international & national projects and industrial partnerships (Airbus, Aldebaran, Awabot...)
General Framework

• Robots share their environments & tasks
  – With humans: cobotics, social interaction, education...
  – Among humans: navigation...

• Current robots exhibit impressive behaviors but:
  – Need to be adapted to human environments;
  – Need robustness and safety to be deployed at a large-scale;
  – Their interactions are often stereotypic and lack context-sensitivity, notably to variety of end-users profiles.
Objectives of RHUM

- Objectives of the EA:
  - Federate a plurisdisciplinary team on RHUM;
  - Networking numerous experimental platforms & sharing resources.

- Grenoble assets
  - Large coverage of complementary expertise on RHUM:
    - 4 labs (GIPSA-Lab, LIG, LJK, TIMC);
    - 10 teams;
    - 26 researchers.
  - Several robots & technical platforms: Nina, Baxter, Pepper...
Organization of RHUM

• 3 complementary actions
  1. 4 working groups (GT) targeting precise scientific challenges;
  2. 2 interdisciplinary inter-GT challenges;
  3. Dissemination, support to challenges and links with teaching.
Working groups (1/2)

- 4 working groups (GT) targeting precise scientific challenges:
  - **Experimentation & robot design (GT0)**: gathering traces/interaction signals (teleoperation & W. of Oz), user-centered design...
  - **Perception & scene comprehension (GT1)**: perception in motion, active perception, reasoning/planning with missing/sparse data...
  - **Action & motion in human envt. (GT2)**: closer coupling between planning & control (predictive control, reactive planning), incremental models...
  - **Social interaction (GT3)**: automatic processing of social signals, automatic learning of behavioral models, user-awareness...

- Pairs of permanent researchers from different labs

- **EA support: 6 M2R internships in 2016**
  - 1 GT0, 2 GT1, 1 GT2, 2 GT3
Working groups (2/2)

- **Subject:** Development of an audiovisual model of attention for a companion robot (GT1)
- **Rémi Ratajczak** - M2R IRIV Strasbourg / D. Pellerin & C. Garbay
- **Results:** Conception & implementation of a rapid audiovisual model of attention that includes the detection and localization of humans for a companion robot Qbo
- **Publication:** the First International Conference on Applications and Systems of Visual Paradigms (VISUAL 2016)
- **Funding:** Qbo was funded by a persyval Exploratory Project between GIPSA-lab & LIG
Scientific Days, June 13th & 14th, 2017

Rémi Ratajczak - M2R IRIV Strasbourg / D. Pellerin & C.

Robot Qbo

Results:
Conception & implementation of a rapid audiovisual model of attention that includes the detection and localization of humans for a companion robot Qbo.

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Funding:
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Subject:
Development of an audiovisual model of attention for a companion robot (GT1)

Working groups (2/2)
- Subject to a companion robot.
- Rémi Ratajczak - M2R IRIV Strasbourg / D. Pellerin & C. Garbay
- Results of a rapid audiovisual model of attention that includes the detection and localization of humans for a companion robot Qbo.
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- Subject: Development of an audiovisual model of attention for a companion robot (GT1).
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Interdisciplinary inter-GT challenges (1/5)

2 interdisciplinary inter-GT challenges

1. **Motion safety in dynamical & uncertain envts**
   - Taking into account human attention/intention
   - Handling dynamic streams
   - Social, cultural & psychological rules of approach/avoidance

2. **Learning/adapting behaviors for social interaction**
   - Learning by demonstration and HRI studies using immersive teleoperation
   - Models of interactive behaviors: perception/action loops & multimodal coordination
   - Adaptation to the task & human partners: choice & adaptation of behavioral models

**EA support: 2 PhD thesis starting in 2017**
- Safe and Appropriate Navigation among People for Service Robots
- Acquiring Human-Robot Interaction skills with Transfer Learning Techniques
Interdisciplinary inter-GT challenges (2/5)

- Safe and Appropriate Navigation among People for Service Robots
- Matteo Ciocca supervised by T. Fraichard/P.B. Wieber

- Integration of Motion Safety into a Model Predictive Control for biped robots to navigate appropriately among people.
  - **Motion Safety** based on Inevitable Collision State (ICS) [T. Fraichard and H. Asama];
  - **People** described via pedestrian modeling;
  - **Control design** according to Feasibility and Stability [D. Q. Mayne et al];
  - **Appropriate navigation** evaluation: controller parameters, reasons of failure.
Interdisciplinary inter-GT challenges (3/5)

• Related Material:
  – [Bohórquez et al, 16] Integration of Passive Safety level into Model predictive control for biped robots;

• First Tasks:
  – Feasibility (and Safety) proof of “relaxed passive safety”, introduced in [Bohórquez et al, 16];
  – Performance evaluation of Passive Friendly Safety (PFS) for biped robots.

• Open Question:
  – Implicit integration of Motion Safety Constraints into the Model predictive control problem.
Interdisciplinary inter-GT challenges (4/5)

- Acquiring HRI skills with Transfer Learning Techniques
- Omar-Samir Mohammed supervised by G. Bailly/D. Pellier
- Transfer planning & control models learned from previous experience between different experimental conditions, tasks and between robots
  - Machine learning (from observations to actions);
  - Interactive data;
  - Distinguish/combine transfer & adaptation
    - Identification of old/new abilities: limits of adaptation;
    - Decompose tasks into a sequence of elementary abilities.
- Toy problem
  - Cursive writing
    - IRONOFF: 550 writers, isolated letters vs. frequent words, French & English);
    - ML challenges: drawings to tracings, drawings/tracings from/to letters, etc;
    - Abilities: stokes, style component, etc.
Interdisciplinary inter-GT challenges (5/5)

• Tasks
  – Identification
    ❖ ImageNet transfer
  – Captioning
    ❖ ML: classification vs. regression
  – Writing styles
    ❖ MDS vs. DNN bottleneck

• Open questions
  – Known/new letter/style
    ❖ Coverage, outliers
    ❖ Goodness of fit
  – Transfer learning
    ❖ New letters
    ❖ Stroke decomposition
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Dissemination, support to challenges and links with teaching

1. Dissemination
   - Website: [http://www.gipsa-lab.grenoble-inp.fr/projet/RHUM](http://www.gipsa-lab.grenoble-inp.fr/projet/RHUM);
   - 1 day workshop (5/2016): 50 local participants, 2 invited speakers, 4 local speakers, posters;
   - 1 “working lunch” (10/2015): posters + discussions;

2. Support challenges
   - Local: PersyCup (persyval “formation”);
   - National & international: national robotic cup, robot design competition (ICSR 2016).

3. Links with teaching
   - Identify existing teaching modules & enhancing their visibility;
   - Robotic courses in future projects (EUR);
   - Support new robotics course: experimental platforms (FABLAB + O. Aycard) (persyval “formation”).

➢ EA support: support for workshops & challenges
Conclusions & perspectives

• Robot as a cyber-physical system evolving in humans environment
  – Transdisciplinary challenge;
  – Major socio-economical challenge: cobotics, social robots...

• Multiscale project
  – Enables specific exploratory works: 4 WG;
  – Supports collaborative works: 2 PhD;
  – Dissemination (+animation/structuration) and support.

• Mobilization of the local community
  – Offers a place for cross-labs exchanges and debates.

• Unique opportunity for structuring & coordinating robotics
  – Offers the possibility to set up a Grenoble identity at the national level;
  – Reassembles a critical mass of researchers in order to shift projects upscale: EUR, CDP (Cross Disciplinary Project), Carnot Cognition, ANR, European project.
Questions?

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