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


Robot Qbo

Working groups (2/2)

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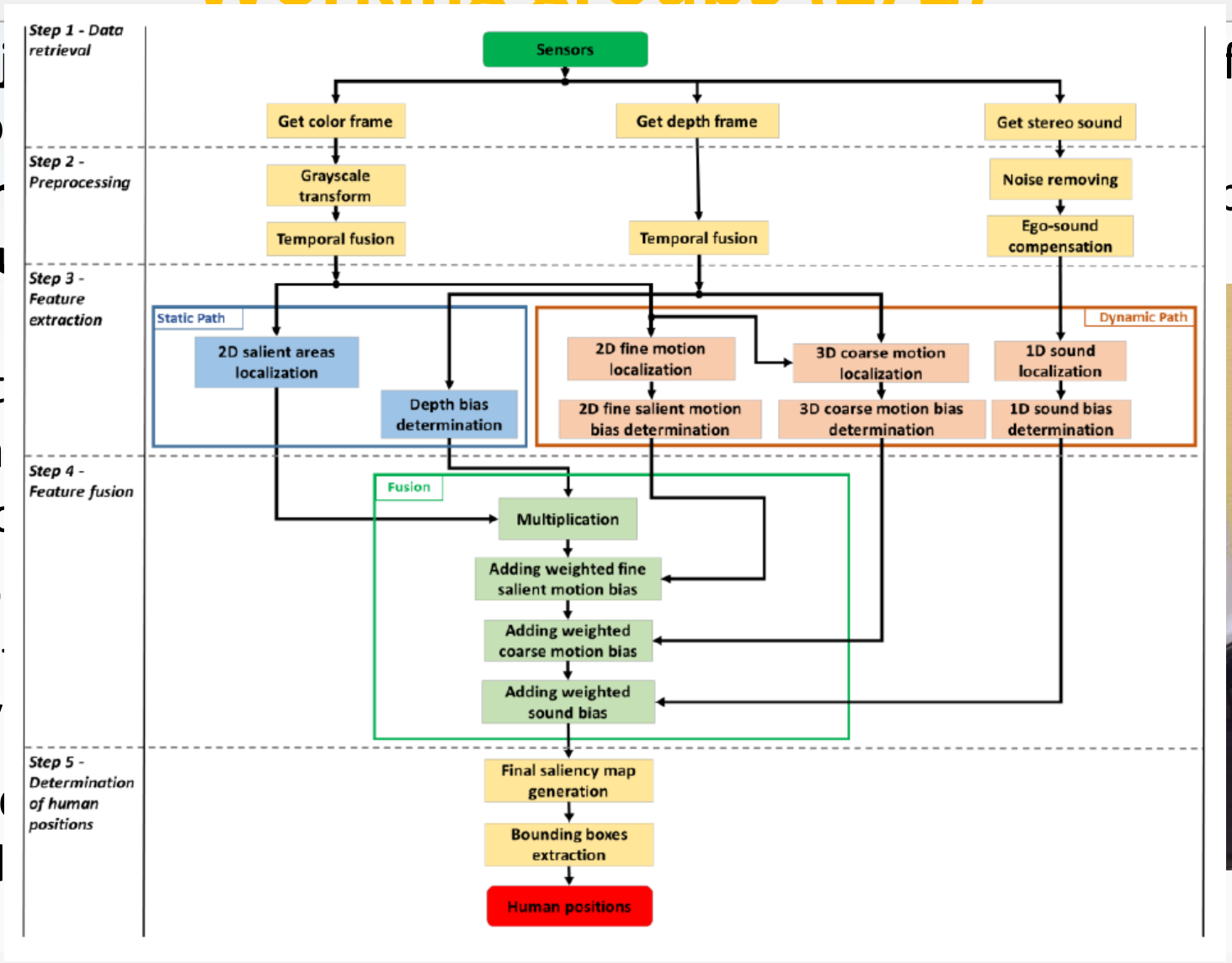

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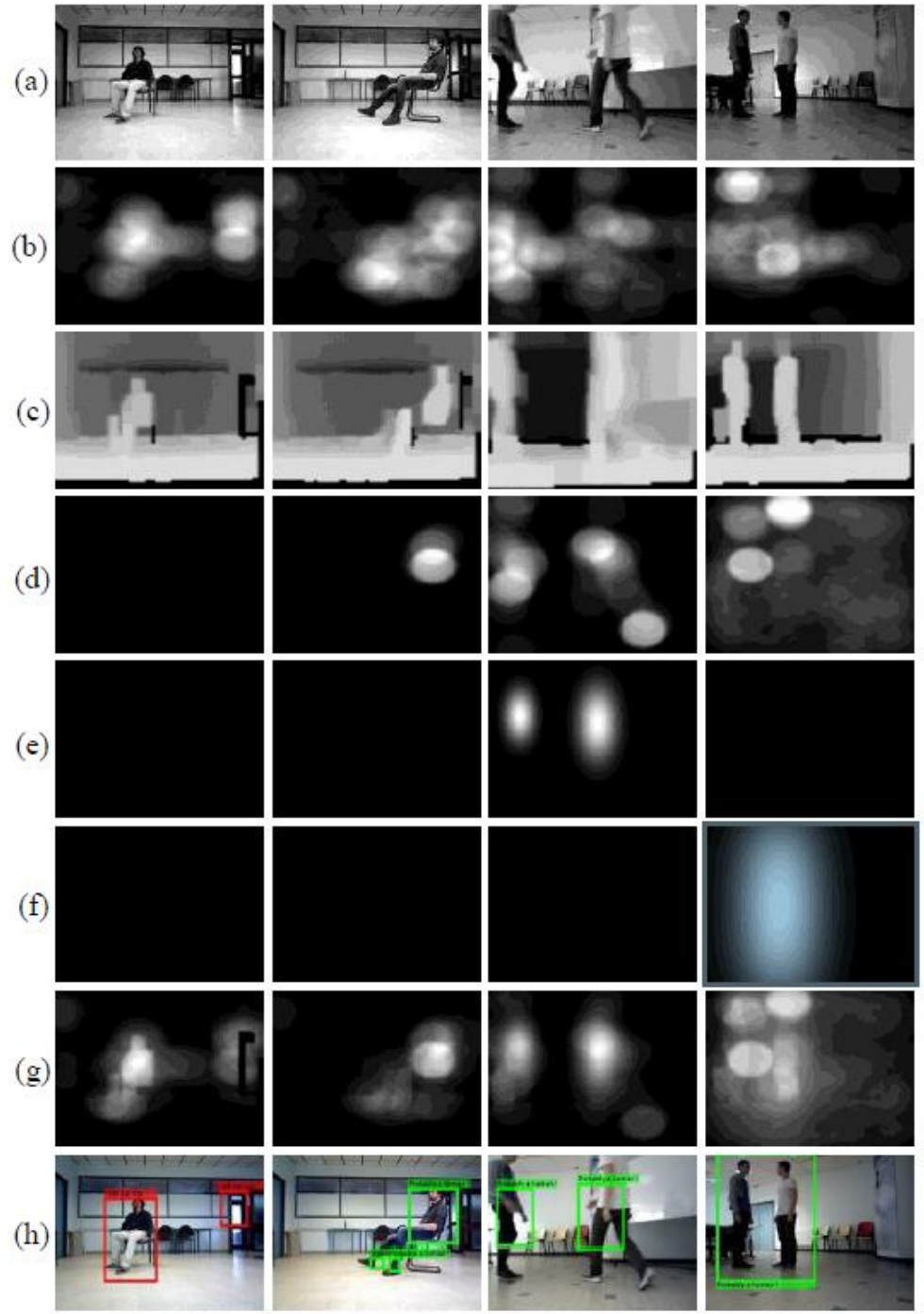

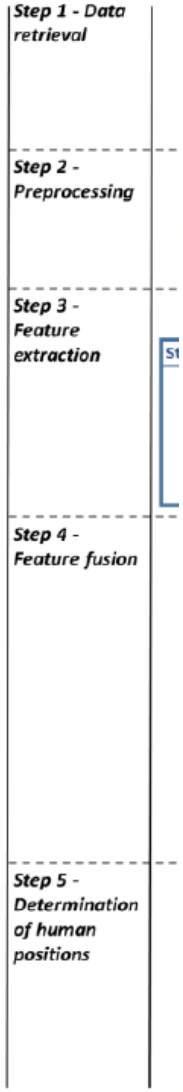

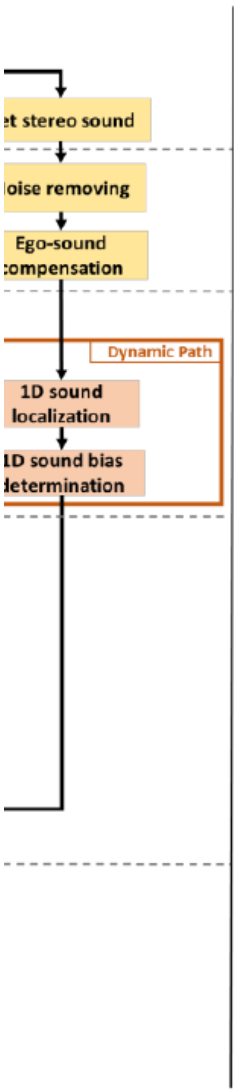

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Interdisciplinary inter-GT challenges (1/5)

- 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)

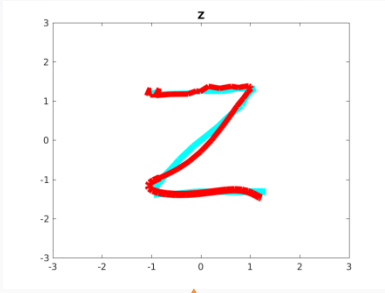
- Related Material:
  - [Bohórquez et al, 16] Integration of Passive Safety level into Model predictive control for biped robots;
  - [Hang Yu Master Thesis] Formal characterization of Passive Friendly Safety (PFS).
- First Tasks:
  - Feasibility (and Safety) proof of "*relaxed passive safety*", introduced 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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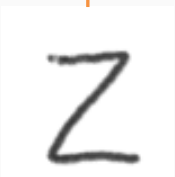

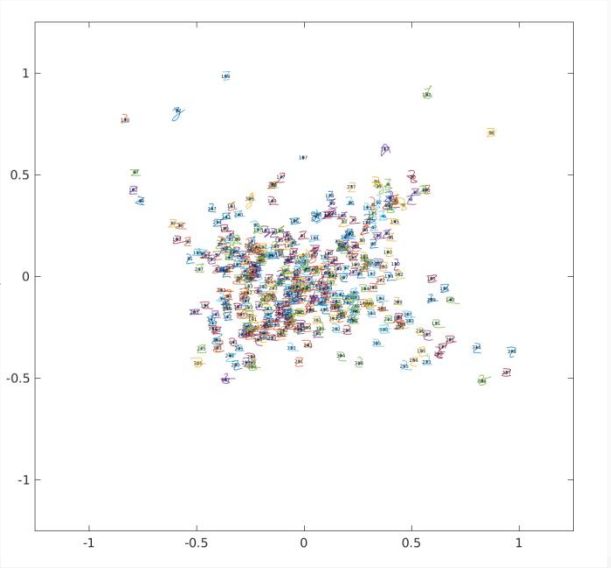

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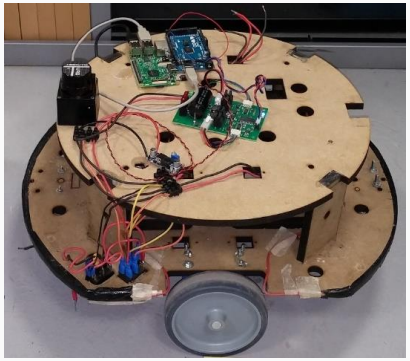
Dissemination, support to challenges and links with teaching

1. Dissemination
   - Website: 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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