CHIST-ERA Projects Seminar 2019

ORMR

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Robots should recognise objects mentioned by a user & fetch them or determine if and how an object can be safely grasped.

However, robot abilities remain limited in practice:
- Lack of large data sets for training robust models for the tasks
- Objective evaluation protocols to test these models in a reproducible way

ORMR - Object recognition and manipulation by robots: Data sharing and experiment reproducibility

New approach: robotic perceptions about the surrounding environment and internal states are recorded, annotated with reference information usable to evaluate models, and shared across researchers working on the same task.
ORMR Projects

- BURG
- CORSMAL
- HEAP
- InDex
- IPALM
- Learn-Real
- RePRoGAM
• “Understand” object perception and grasping → objects and parts
• Learn from real & virtual data
• Tools to build up benchmark scene
• Rigid and flexible objects
- To create an open dataset and an evaluation protocol for recognition and manipulation of previously unseen objects

- To explore the fusion of multiple sensing modalities (touch + sound + vision) to accurately and robustly estimate the physical properties of objects in noisy and potentially ambiguous environments for dynamic hand-overs
InDex: Robot In-hand Dexterous manipulation...

- By extracting data from human manipulation of objects
- Create a multimodal dataset of in-hand manipulation
- To improve robotic autonomy and dexterity
Automatic digitization of objects and their physical properties by exploratory manipulations.

Learning physical properties of objects from: vision, touch, audio and text.

A benchmark and a database of object models with a variety across properties
**Heap - Human-Guided Learning and Benchmarking of Robotic Heap Sorting**

- Sort objects in a heap
- Known objects but cope with unknown broken parts
- Use simulation and real data for learning
- Applications: nuclear, waste, disaster, …
As for humans and other animals, robot learners need to be exposed to varied situations to acquire skills.

We will build a simulation and evaluation toolset considering several forms of variations → Varied learning modalities, textures, reflections, lighting and dynamic rendering.

We will extend the BEAT platform (initially targeting reproducible research in biometrics) to benchmarks in robot manipulation.

Case study: fruits/vegetables picking.
- Perception-guided robust and reproducible robotic grasping and manipulation

- Two applications for industrial settings with non-ideal conditions:
  - Bin-picking of reflective objects
  - Waste-material handling

- Two research thrusts:
  - Vision: detection of graspable features rather than objects
  - Grasping and regrasping: based on physical model, no machine learning
Major Achievements and Outputs

- Provide community with Databases and tools for evaluation for learning robot object grasping and manipulation

- Tool for replicating the same scene in different labs (BURG)
- Grasp quality index, mechanical design of hands (PeGRoGAM)
- Simulator with realistic variations of scene rendering including dynamics (LEARN-REAL, CORSMAL)

- Force roboticists to generalise to other robots, shareable
- Excellent students, experts in perception and robot manipulation
Grasping is more than a DB → interaction with the real world
Need to reproduce scene & process, materials, touch, etc.

Repeatablity gap
Dynamic process: touch, robot-object interaction
Dynamic perception: moving camera and view point, reflections, varying lighting conditions, different material properties
Human in the loop: handover
Flexible objects

Different robots, different cameras, different x

Needs: How to get the contracts for Italian and Spanish partners
Possible Roadmap

- Create a set of „famous“ CHIST-ERA benchmarks
  - Make sure the partners introduce them to the community
  - Create critical mass and impact
  - Create joint emailing list, joint webpage (ORMR.EU?)
- Joint workshops at ICRA 2020 in Paris and IROS 2021 in Prague
  - Demonstrations how robots learn and what they can do
- Possible workshop at CVPR, NIPS
- General Perspective: beyond end-to-end learning, „understand“ and reproduce grasping and manipulation
- Push ML towards reproducibility needed by industry
Excellent support for scientific R&D

Specific call created synergies between projects
- In sum more than a single endeavour
- Joint narrative, e.g., joint overview paper
- Video on this topic for the wider public

Exploitation towards industry: ERF or AUTOMATICA

Crossing the step from laboratory to real world
- Picking soft, soft objects in difficult situations, e.g., fruits & vegetables outside
- Sorting debris, broken objects, etc.
- Bin picking of reflective, transparent objects or dangerous objects (hot, radioactive)
- Making order at home, e.g., putting items in a fridge
Questions