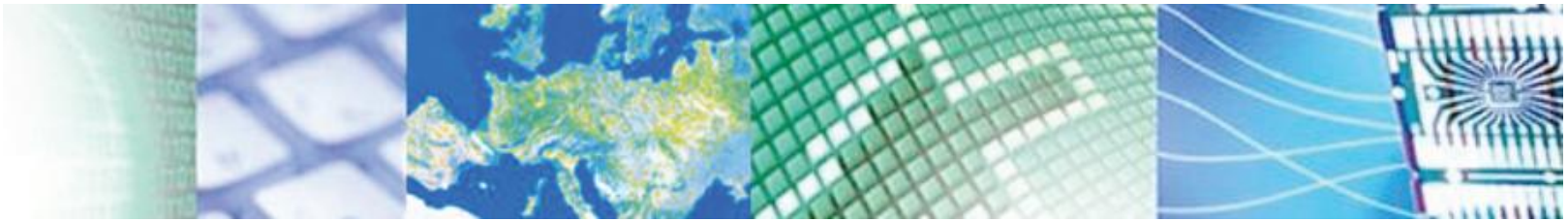


CHIST-ERA Projects Seminar 2019

ORMR

Markus Vincze (TU Wien)

Bucharest, April 4, 2019

Programme co-funded by the
EUROPEAN UNION

Introduction of the Topic - ORMR

- **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

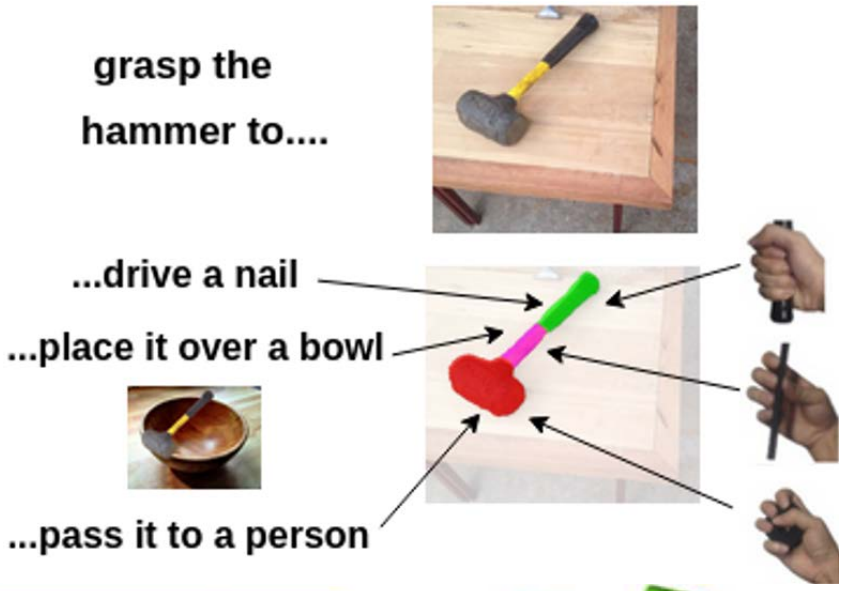
- **New approach: robotic perceptions about the surrounding environment and internal states are recorded, annotated with reference information usable to evaluate models, and shared across researchers working on the same task.**

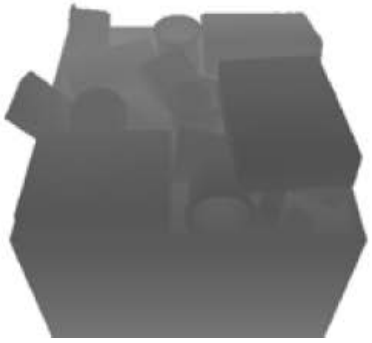
ORMR Projects

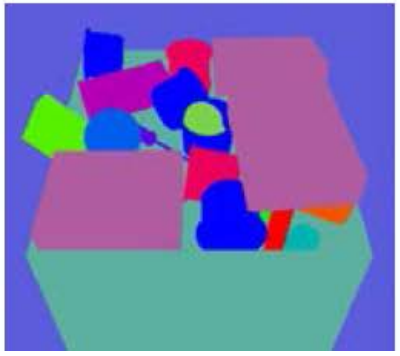
- BURG
- CORSMAL
- HEAP
- InDex
- IPALM
- Learn-Real
- RePRoGAM

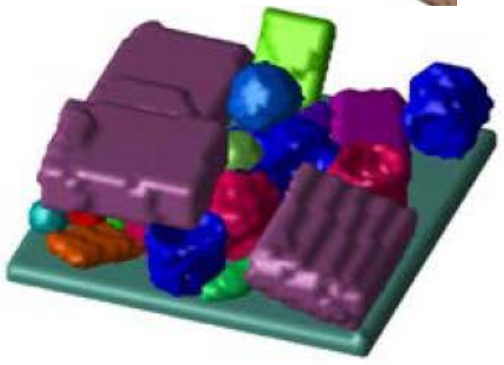
BURG
Benchmarks for UndeRstanding Grasping

- "Understand" object perception and grasping → objects and parts
- Learn from real & virtual data
- Tools to build up benchmark scene
- Rigid and flexible objects









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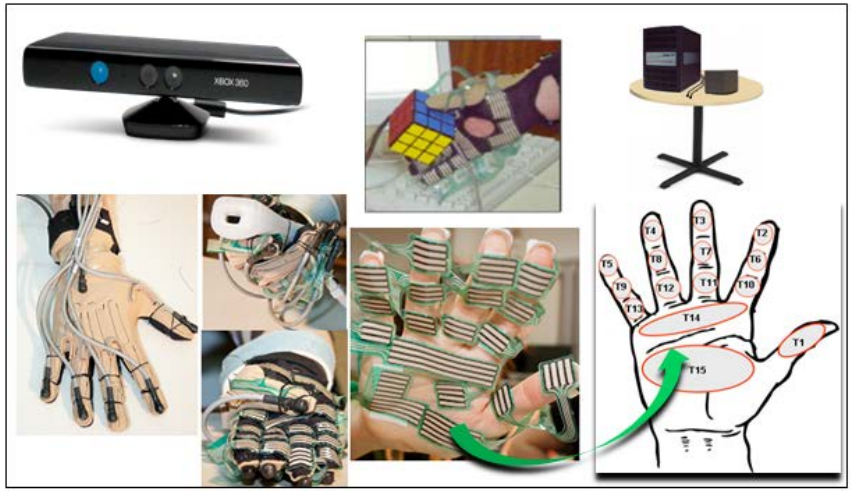
CORSMAL: Collaborative Object Recognition, Shared Manipulation And Learning

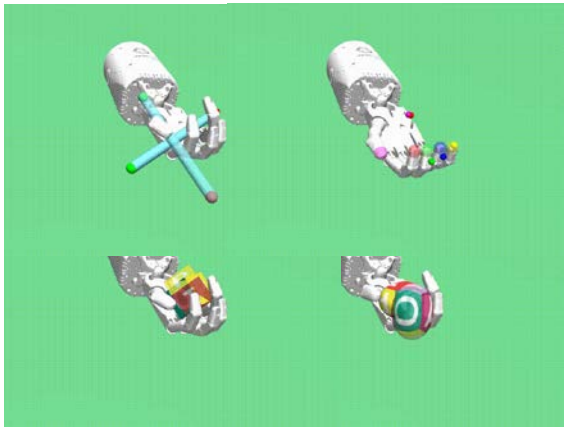
- To create an open dataset and an evaluation protocol for recognition and manipulation of previously unseen objects

- 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

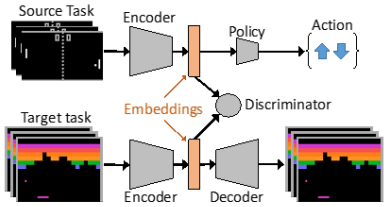
InDex: Robot In-hand Dexterous manipulation …

- By extracting data from human manipulation of objects
- Create a multimodal dataset of in-hand manipulation
- To improve robotic autonomy and dexterity





Multi-modal represenation



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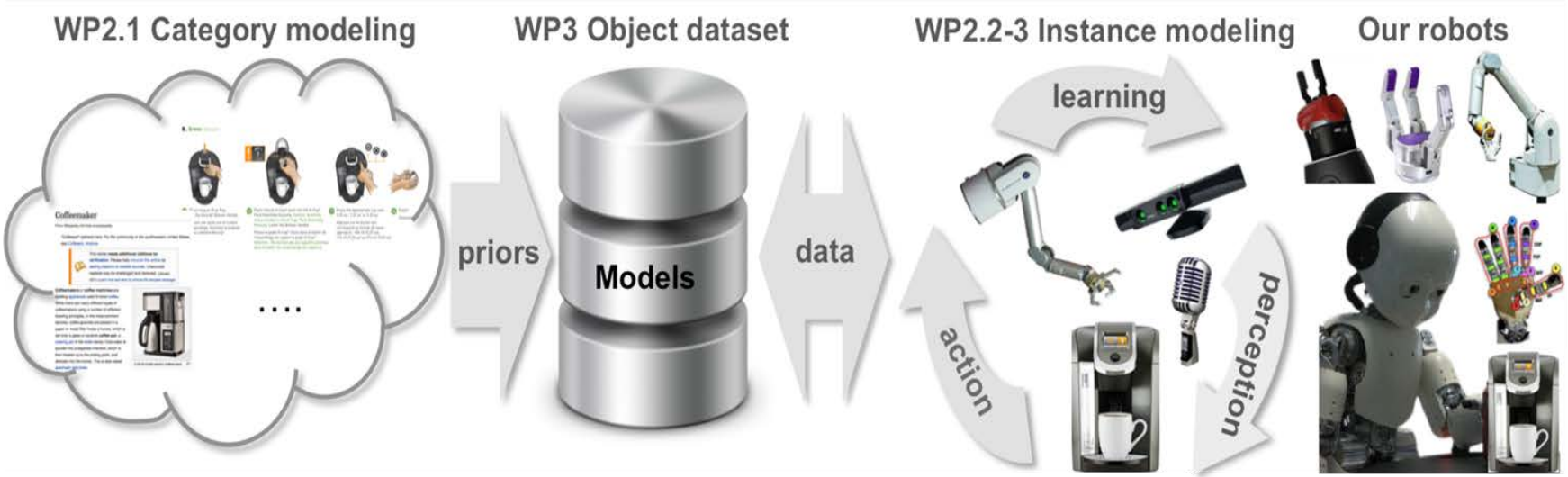
IPALM: Interactive Perception-Action-Learning for Modelling Objects



- **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**

Imperial College London

Aalto University

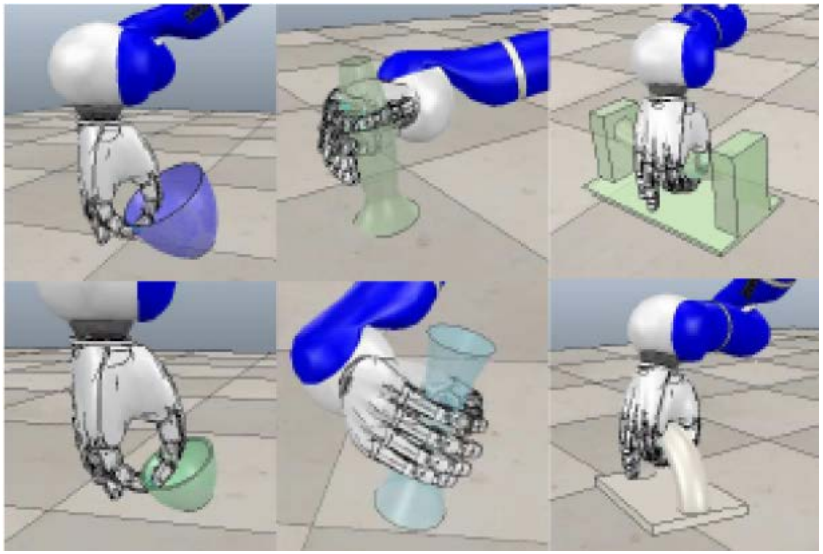
université de BORDEAUX

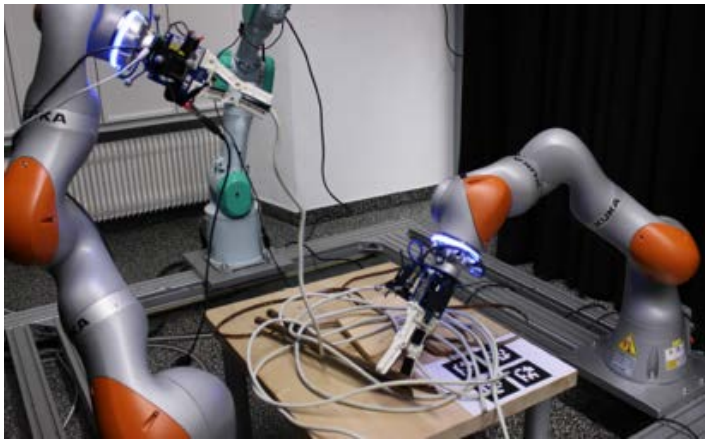
Institut de Robòtica i Informàtica Industrial

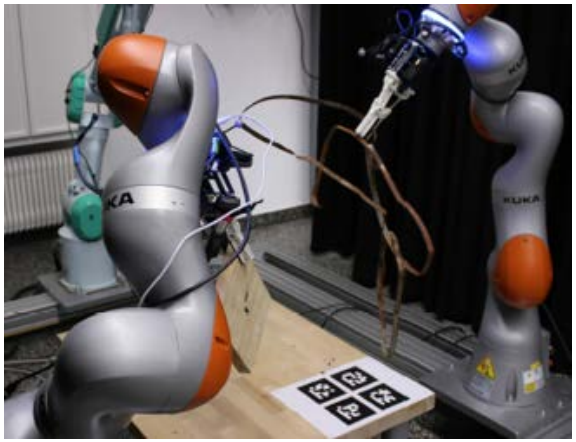
CTU CZECH TECHNICAL UNIVERSITY IN PRAGUE

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, …

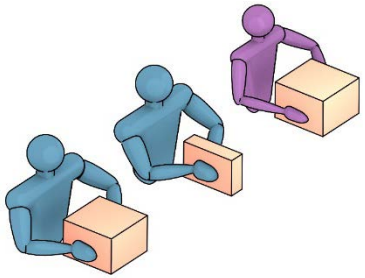


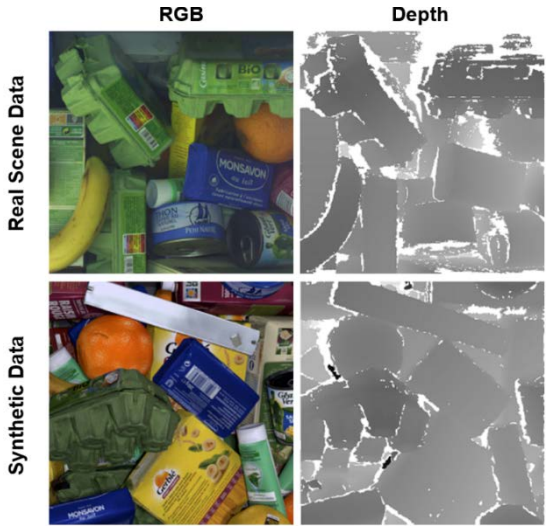




Learn-Real: **Learn**ing Physical Manipulation Skills with Simulators using **Real**istic Variations

- 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





https://www.beat-eu.org/

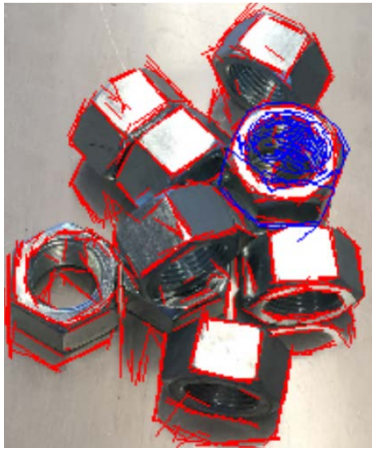
Consortium

Idiap Research Institute

Italian Institute of Technology

École Centrale de Lyon

- **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

Topic Challenges and Needs

- **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 intruduce 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**

Role of the CHIST-ERA Support

- **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

Questions ?