VLRA: Vision and Learning for Robotic Applications

Special track along with ICAS 2020
The Sixteenth Conference on Autonomic and Autonomous Systems

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IARIA

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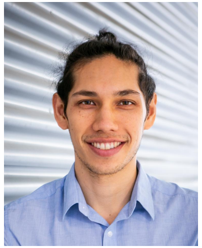


Dr. Timothy Patten received his PhD from the Australian Centre for Field Robotics at the University of Sydney, Australia. He is now a postdoctoral researcher with the Vision for Robotics laboratory at the Technical University of Vienna, Austria. His research focuses on object tracking, modeling, and grasping.

Co-Chair

Dr. Geraldo Silveira received his PhD from the École Nationale Supérieure des Mines de Paris (MINES ParisTech)/INRIA Sophia Antipolis, France. He is now a senior research scientist with the Robotics and Computer Vision group at CTI, Brazil. His research interests include vision-based estimation and robot control.

About the VLRA Special Track

Aim

- To promote the development of computer vision and learning in robotics for solving real-world applications

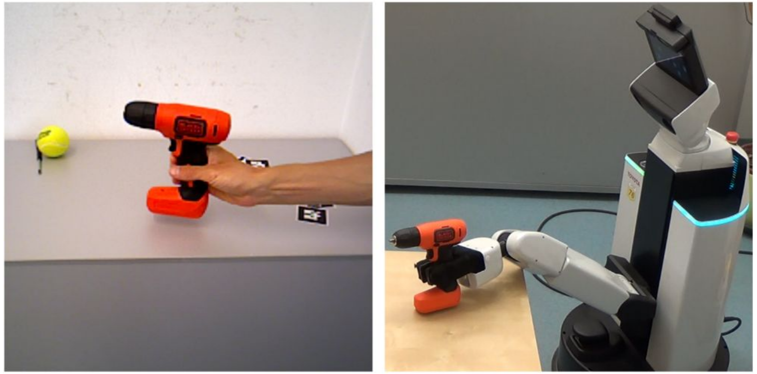
Topics of interest

- Technological developments for robot vision
- Robot and machine vision in the wild
- Object detection, recognition and tracking
- Visual learning
- High-speed control
- Application of reinforcement learning and deep learning in robotics
- Advanced grasping and manipulation
- Robots for service, industry, autonomous driving, transportation, agriculture and construction

Summary of Contributions (1)

Title: Imitating Task-oriented Grasps from Human Demonstrations with a Low-DoF Gripper
Authors: Timothy Patten and Markus Vincze
Paper ID: 28005

- Framework for a robot to learn how to grasp objects by directly observing a human demonstration
- Neural network to translate higher-DoF human hand pose to the lower-DoF parallel-jaw gripper
- Real-world grasping experiments; objects grasped with a high success rate when presented in new poses after only observing a single human demonstration



Human demonstrates how to semantically grasp an object by lifting a drill by the handle

Summary of Contributions (2)

Title: Computation of Suitable Grasp Pose for Usage of Objects Based on Predefined Training and Real Time Pose Estimation

Authors: Muhammed Tawfiq Chowdhury, Shuvo Kumar Paul, Monica Nicolescu, Mircea Nicolescu, David Feil-Seifer and Sergiu Dascalu

Paper ID: 28008

- Train humanoid robot with different types of task-relevant grasp poses
- Two object pose estimation techniques:
  (1) color-based method for linear objects and
  (2) homography-based method for objects with complex shape
- Implemented on PR2 manipulator and grasping with both arms of objects on tripod or presented in the hand of a human participant

Side grasp of a wench using the right gripper of the PR2 mobile manipulator

Summary of Contributions (3)

Title: Semantic Segmentation for the Estimation of Plant and Soil Parameters on Agricultural Machines

Authors: Peter Riegler-Nurscher, Johann Prankl and Markus Vincze

Paper ID: 28006

- Many machine vision problems in agriculture can be solved with semantic segmentation
- Presents four different applications: (1) soil cover estimation, (2) estimation of grass-legumes ratio, (3) grassland swath detection and (4) grassland cut segmentation
- Investigates the influence of different pre-training methods to improve the classification performance of a CNN model

Image for segmentation of areas of cut grass (left), test mask (middle), ground truth map (right); standing meadow in green, grass turf in dark brown, machine in light brown and mown grass in red

Summary of Contributions (4)

Title: Reference Detection for Off-road Self-driving Vehicles using Deep Learning
Authors: Marcelo Eduardo Pederiva and Ely Carneiro de Paiva
Paper ID: 28009

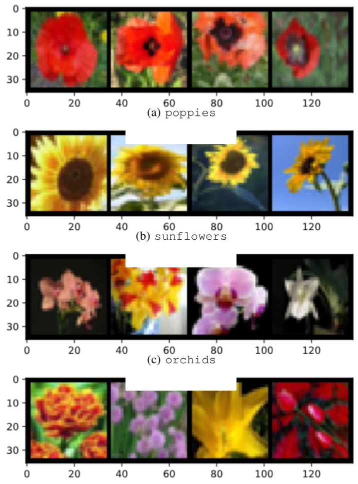
- Studies the application of deep neural network models to detect references in off-road driving for autonomous vehicles
- Compares Faster R-CNN, SSD300 and Fast YOLOv2 object detection models
- Experiments show the pros and cons of each model as well as the possible application scenario for each

Comparison of detection methods: Faster R-CNN (left), SSD300 (middle) and Fast YOLOv2 (right)

Summary of Contributions (5)

Title: In the Depths of Hyponomy: A Step Towards Lifelong Learning
Authors: Tommaso Boccato, Timothy Patten, Markus Vince and Stefano Ghidoni
Paper ID: 28013

- Proposes a novel framework for lifelong learning of semantic classes in order to extend the operational time of robots deployed in the real world
- Framework keeps track of the intra-class variability over time in order to refine the class definition
- Presents a metric to quantify the intra-class variability, which leads to automatic triggering of the class restructuring



Randomly sampled batches extracted from different sub-classes of the same super-class; *how does the intra-class variability impact a classifier and how can a robot recognize and exploit this phenomenon?*

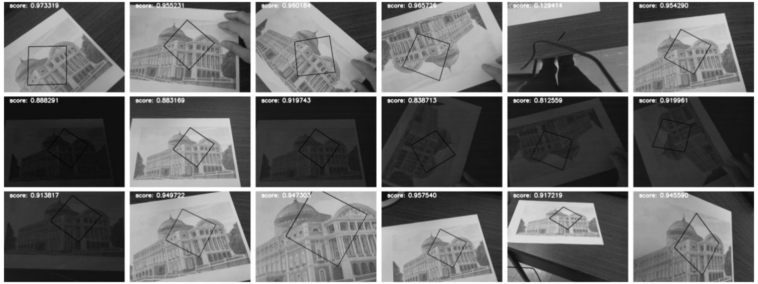
Summary of Contributions (6)

Title: Towards a Unified Approach to Homography Estimation Using Image Features and Pixel Intensities

Authors: Lucas Nogueira, Ely Paiva and Geraldo Silveira

Paper ID: 28014

- Proposes a new hybrid optimal method to estimate the homography matrix that unifies feature- and intensity-based approaches
- Applies the same nonlinear optimization method, and uses the same homography parameterization and warping function
- Improved convergence properties over individual cases and is real-time capable



Excerpts of the homography-based visual tracking using the proposed unified approach

Future Challenges

- Collecting datasets to train learning algorithms
  - How much data is needed?
  - How to annotate this data efficiently?
- Further integrating vision and learning for real-time operation
  - What are the appropriate interfaces?
  - Where are the bottlenecks in the system?
- Deploying an ensemble of algorithms for different situations
  - Which algorithm is appropriate for each situation?
  - How to recognize the situation and switch between method?
- Extending the operation life of robots through self-supervision
  - How to deal with the open world, i.e., unknowns?
  - How to enable a robot to identify its limitations and extend its knowledge?