RA6 - Advanced Robot Autonomy

Miroslav Kulich

CIIRC, Czech Technical University in Prague

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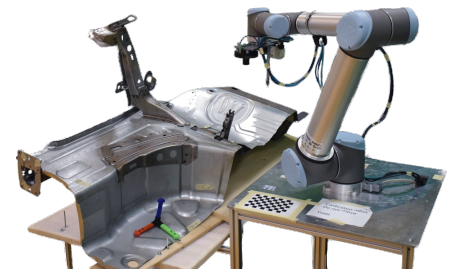
RA6: Advanced robot autonomy

- Two groups:

  - G6: Intelligent and Mobile Robotics, CIIRC
  - G10: Artificial Intelligence Center, FEE

- RO 6.1 - **Robot workspace modelling, robot under uncertainty** (G6, Košnar)
- RO 6.2 - **Perception-based navigation using embedded workspace features** (G6, Přeučil)
- RO 6.3 - **Long-term autonomy, fault detection and recovery** (G6, Kulich)

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RA6 people: CIIRC + FEE

Dr. Libor Přeučil
(RA leader)

Dr. Karel Košnar
(Excellent TT)

Dr. Miroslav Kulich
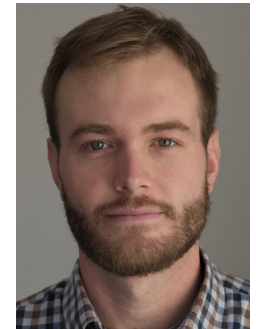(Excellent T)

doc. Tomáš Krajník
(Excellent T)

Viktor Kozák
(PhD student)

Tomáš Pivoňka
(PhD student)

Tomáš Rouček
(PhD student)

Zdeněk Rozsypálek
(PhD student)

+2 positions (acquiring)

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RO 6.1 Robot workspace modelling, robot under uncertainty

- A priori knowledge (exploration, previous operation) x map update

- Uncertainty due to
  - incomplete information
  - dynamics in the environment (movement of objects, human presence, human-robot collaboration)

- Vision-based spatial semantic mapping & visual place recognition for robot localization and navigation
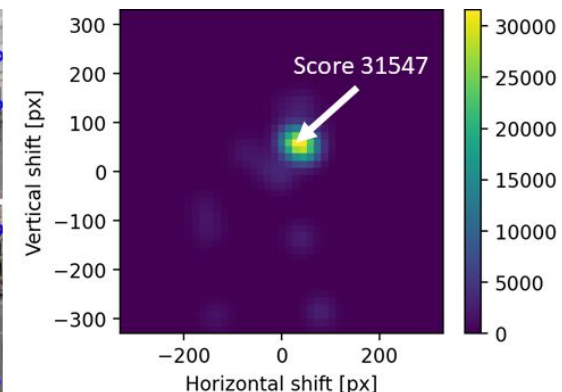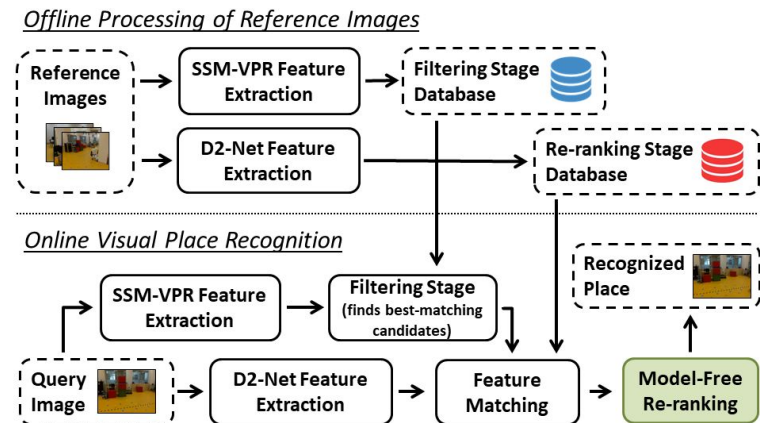
Camara, L.G., Přeučil, L. (2020) *Visual Place Recognition by spatial matching of high-level CNN features.* Robotics and Autonomous Systems.
Camara, L.G., Gäbert, C., Přeučil, L. (2020) *Highly Robust Visual Place Recognition Through Spatial Matching of CNN Features.* ICRA
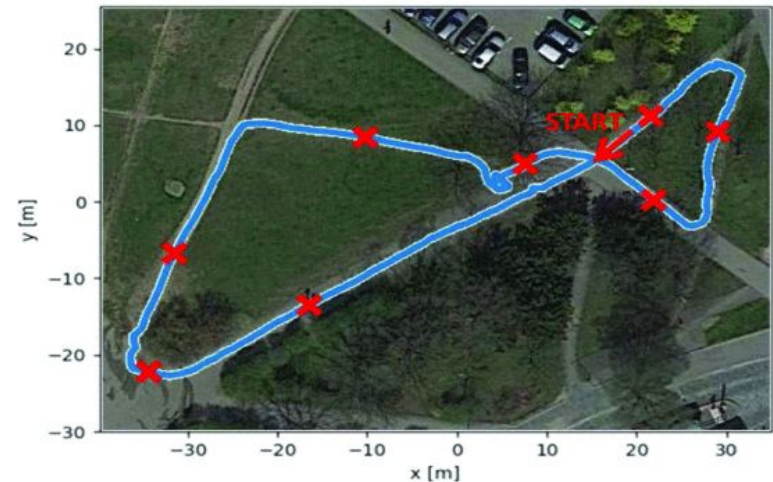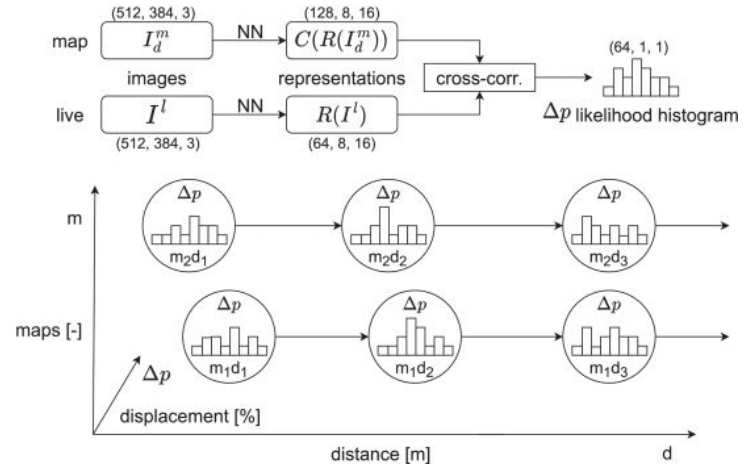
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RO 6.2 - Perception-based navigation using embedded workspace features

- Visual teach and repeat navigation with visual place recognition

- Influence of visual features and their distribution

- Evaluation of navigation method self-confidence

- Navigation in dynamic environments

Z. Rozsypálek, T. Rouček, T. Vintr and T. Krajník (2023). *Multidimensional Particle Filter for Long-Term Visual Teach and Repeat in Changing Environments*. IEEE Robotics and Automation Letters
Kozák, V., Pivoňka, T., Avgoustinakis, P., Majer, L., Kulich, M., Přeučil, L., and Camara, G. L. (2021). *Robust Visual Teach and Repeat Navigation for Unmanned Aerial Vehicles*. ECMR
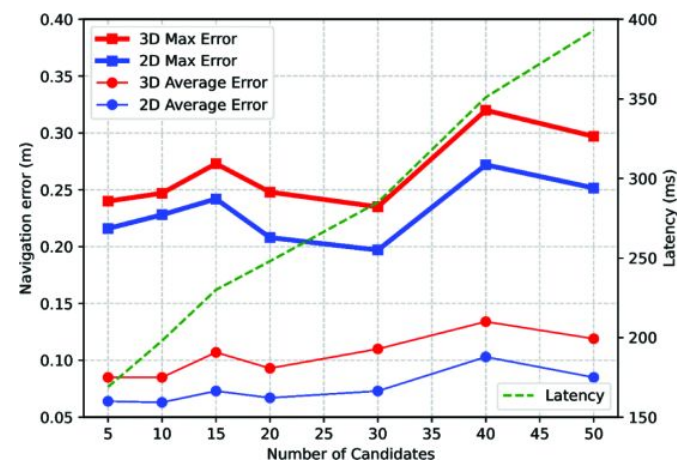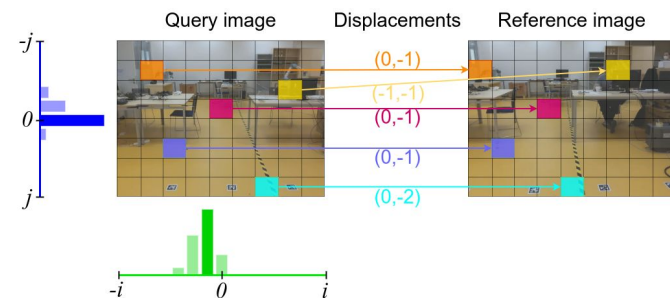
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RO 6.3 - Long-term autonomy, fault detection and recovery

Even good navigation strategies can fail =>

- failure prevention, detection & mitigation:
  - robot state/task execution/self-confidence monitoring,
  - failure-aware planning
- failure classification
- recovery strategies:
  - retiming
  - adjust the current plan
  - replan

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Collaboration & cooperation

International collaboration

- Workspace modelling
  - B. Hein, KIT, DEU
  - A. Lilienthal, TUM, DEU
- Navigation
  - I. Petrovic, Uni Zagreb, HRV
  - R. Sell, TalTech, EST
- Long-term autonomy
  - K. Soeren, Fraunhofer IML, DEU

Cooperation with other groups

- RA 10 (J. Faigl): planning/routing
- RA 11 (Z. Hanzálek): decision making for long term autonomy
- RA 8 (M. Saska): unmanned aerial systems

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