

Doctoral School of Information and Biomedical Technologies
Polish Academy of Sciences (TIB PAN)

Subject:

Precise, accurate and robust simultaneous localisation and mapping for automating trees' inventory

Supervisor:

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Description:

Automating trees' inventory requires precise, accurate and robust simultaneous localisation and mapping (SLAM) capability. The working environment is demanding since it can not be considered as structured where there are sufficient methods for solving this problem [1][2][3][4]. Moreover, SLAM can be facilitated with recent advances in AI domain such as trees' segmentation and classification what is considered as crucial for large scale surveys. Thus, novel loop closure techniques will be investigated during project. Moreover, automating trees' inventory will be done with wearable mobile mapping systems and mobile robots. For this reason an embedded solutions will be the expected outcome of the research. Another important research direction is related with distributed computing enabling remote data processing by AI embodiment. This AI embodiment will centralize all intelligent reasoning and will allow processing data collected with various remote sensing tools.

Key tasks of the project include:

1. Analysis of the SoA SLAM techniques done by designing open source framework that can improve benchmarking existing solutions.
2. Collecting data sets, annotating, providing ground truth and other necessary meta data for qualitative and quantitative evaluation.
3. Design loop closure method incorporating deep neural networks for trees' segmentation and classification.
4. Design the solution for "kidnapped robot" problem (recovery from catastrophic localization failures).
5. Improving the accuracy, precision and robustness of SLAM compared to existing approaches.
6. To perform field test with wearable mobile mapping systems and mobile robots.
7. Design remote data processing as AI backpack system embodiment.

Candidate Requirements:

1. A Master's degree (M.Sc.) in Computer Science or a relevant field.
2. Proficiency in Python and C++ programming.
3. Experience in system integration and software deployment.
4. Preferentially experience in at least one of the following areas:
 - Implementation and training of neural networks.
 - Profiling and refactoring code.
 - A strong scientific curiosity and interest in AI.
 - Experience in software engineering, integration and deployment.

Candidate should contact dr hab. inż. Janusz Będkowski (januszbedkowski@gmail.com) before formal submission of documents.

Bibliography:

- [1] J. Będkowski, End to end navigation stack for nuclear power plant inspection with mobile robot, *SoftwareX* 26, 101750
- [2] J. Będkowski, Open source, open hardware hand-held mobile mapping system for large scale surveys, *SoftwareX* 25, 101618
- [3] J. Będkowski, Benchmark of multi-view Terrestrial Laser Scanning Point Cloud data registration algorithms, *Measurement* 219, 113199
- [4] J. Będkowski, *Large-Scale Simultaneous Localization and Mapping*, Springer, 2022