AARHUS UNIVERSITY

Rev. 10/5-2023

Specifications of Bachelor project for BEng students at Aarhus University / Dept. of Electrical and Computer Engineering

Please fill out the form and send it to Rasmus Nielsen (rani@ece.au.dk). When is has been approved by the Head of degree programs it will be published on Brightspace. A supervisor will be allocated at the end of the semester.

Date	24/11/2024											
Project title	Comparison of Monocular Visual(-Inertial) Odometry											
The project applies to at least 2 students within: (Multiple selections are welcome)	Electronic Engineering		Software Technology		Electrical Power Technology		Healthcare Technology					
	x		x									
Who has initiated the project? (Mark with an X in either Student, Company, or ECE Staff)	Student(s)	Name 1:			Name 2:				Name 3:			
		Mads Evander Jensen			Jeppe Emil Smedegaard Pape							
		Student number 1:			Student number 2:				Student number 3:			
		202107547			202008596							
	Mark with X	E	SW	EE	ST	E	SW	EE	ST	E	SW	EE	ST
		X					X						
	Company	Company name		Contact name		Email		Phone					
	ECE Staff	Name				Email							
	x	Andriy Sarabakha				andriy@ece.au.dk							
Requested supervisor (need only be filled out if relevant) – May be overruled by ECE if necessary	The supervisor has been contacted and has indicated a willingness to supervise the project											
	Name of ECE staff			Email								
	Andriy Sarabakha			andriy@ece.au.dk								
Special demands to: – Equipment – Place – Confidentiality												

Questions about the *content* of bachelor projects can be directed to the head of degree programs:

- Electronic Engineering
- Software Technology
- Electrical Power Technology
- Healthcare Technology

Bachelor project learning goals

- Translate research results and scientific and technical knowledge into practice by using them in development projects and in the solving of technological problems.
- Search for, analyse and assess new knowledge within relevant areas.
- Develop new solutions.
- Use engineering theories and methods in a systematic manner.
- Assess and explain project results to engineers and other target groups, in speech as well as in writing.
- Consider how the project results can be applied socially, organisationally, environmentally, economically, ethically and in relation to sustainability and work environment.

Please describe the project in the field on the next page. Be sure to include:

- What is to be developed?
  - Due to the learning goals of Bachelor of Engineering, the bachelor project must be oriented towards development.
- Sufficient details to allow the head of degree programs to understand why the project is relevant for each specialization.
- What might the technologies involved be (software, hardware, processes)?
- If the project depends on external factors, e.g., access to equipment or data do you have a plan for proceeding if the equipment or data is delayed or unobtainable?
- Is the project realistic in scope pertaining to a bachelor project (time/money)?
  - If the project is large in scope with regards to time, consider stating a prioritized list of features to develop conforming to the MoSCoW method allowing agile development
- Illustrations and figures to illustrate the problem and the envisioned product or context.
- One or two references (e.g., scientific articles) if appropriate.

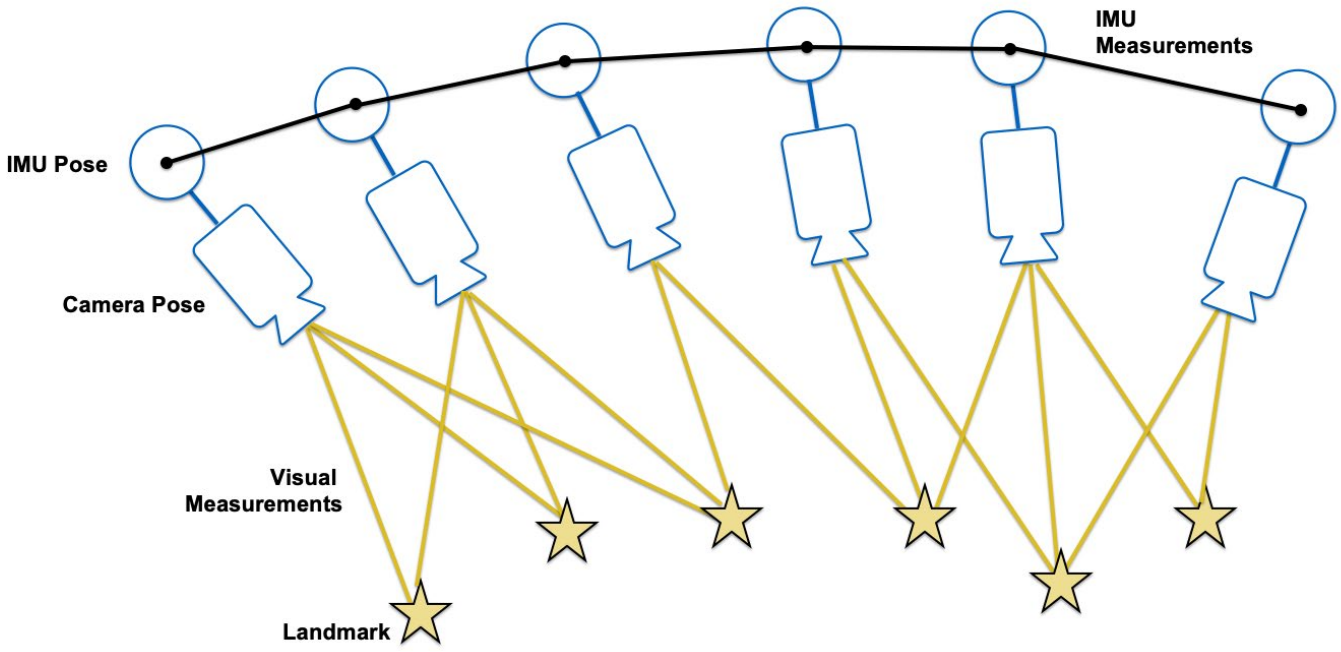
Project description

Objective:
The aim of this project is to compare several existing monocular visual and visual-inertial odometry methods for simultaneous localisation and mapping in an aerial robotics case study.

Motivation:
Monocular visual-inertial odometry estimates the position and orientation of the robot using camera and inertial measurement unit (IMU) sensor data. Camera-based state estimation is accurate during low-speed navigation. However, camera-based estimation faces challenges like motion blur and track loss at higher speeds. Also, a monocular camera-based estimation can estimate poses at an arbitrary scale. On the other hand, inertial navigation can handle high-speed navigation easily and estimate poses at a world scale. Combining the advantages of both types of sensor data is possible to achieve better accuracy. Visual-inertial odometry is currently applied to state estimation problems in a variety of domains, including autonomous robots.

Requirements:
- Good programming skills in C++.
- Experience in robot operating system (ROS).

References:
[1] J. Delmerico and D. Scaramuzza, "A Benchmark Comparison of Monocular Visual-Inertial Odometry Algorithms for Flying Robots," in *2018 IEEE International Conference on Robotics and Automation (ICRA)*, Brisbane, QLD, Australia, 2018, pp. 2502-2509, doi: 10.1109/ICRA.2018.8460664
[2] M. Servieres, V. Renaudin, A. Dupuis, and N. Antigny, "Visual and Visual-Inertial SLAM: State of the Art, Classification, and Experimental Benchmarking", *Journal of Sensors*, vol. 2021, 2021, doi: 10.1155/2021/2054828
[3] https://github.com/klintan/vo-survey



Comments from head of degree: