Power Modeling and Optimization of UAV Software for Heterogeneous Embedded Systems

January 28, 2019

PhD Plan Poster of Adam Seewald (ads@mmmi.sdu.dk)
Principal supervisor: Associate Professor Ulrik Pagh Schultz
SDU Unmanned Aerial Systems Center (Drone Center)

Introduction

None of our daily routines seem possible without the heavy involvement of Embedded Systems. They are a key feature of any modern technology. Mobile robots and factory process controllers are all examples of embedded systems [2].

Visual sensing techniques have been integrated in the control pipeline of robotics systems, such as Unmanned Aerial Vehicles (UAVs), in order to enhance their navigation and guidance skills [3]. These techniques can be used to perform autonomous tasks in modern Unmanned Aerial Systems (UAS), including dynamic path planning, obstacle avoidance, environment mapping, and object recognition.

Problem Statement

Energy usage is a non-functional property that is highly unpredictable, and thus a traditional approach dealing it is not enough to obtain its satisfiability. The challenging task to **program an embedded system while searching for the most appropriate trade-off in non-functional properties' satisfiability** is the major topic of this thesis.

Contributions

The thesis aims to investigate the state-of-the-art solutions and to propose novel techniques to obtain low-power software for Aerial Robotics use cases within the Horizon 2020 funded project **TeamPlay**. The project plans to develop new formally-motivated techniques to analyse effectively non-functional properties as execution time, security and energy usage of parallel software, and to build these techniques into a toolbox for developing highly parallel software for low-energy systems. The project has the goal to achieve significant progress on how to effectively manage energy consumption for parallel systems while maintaining the right balance with others important software metrics [1].

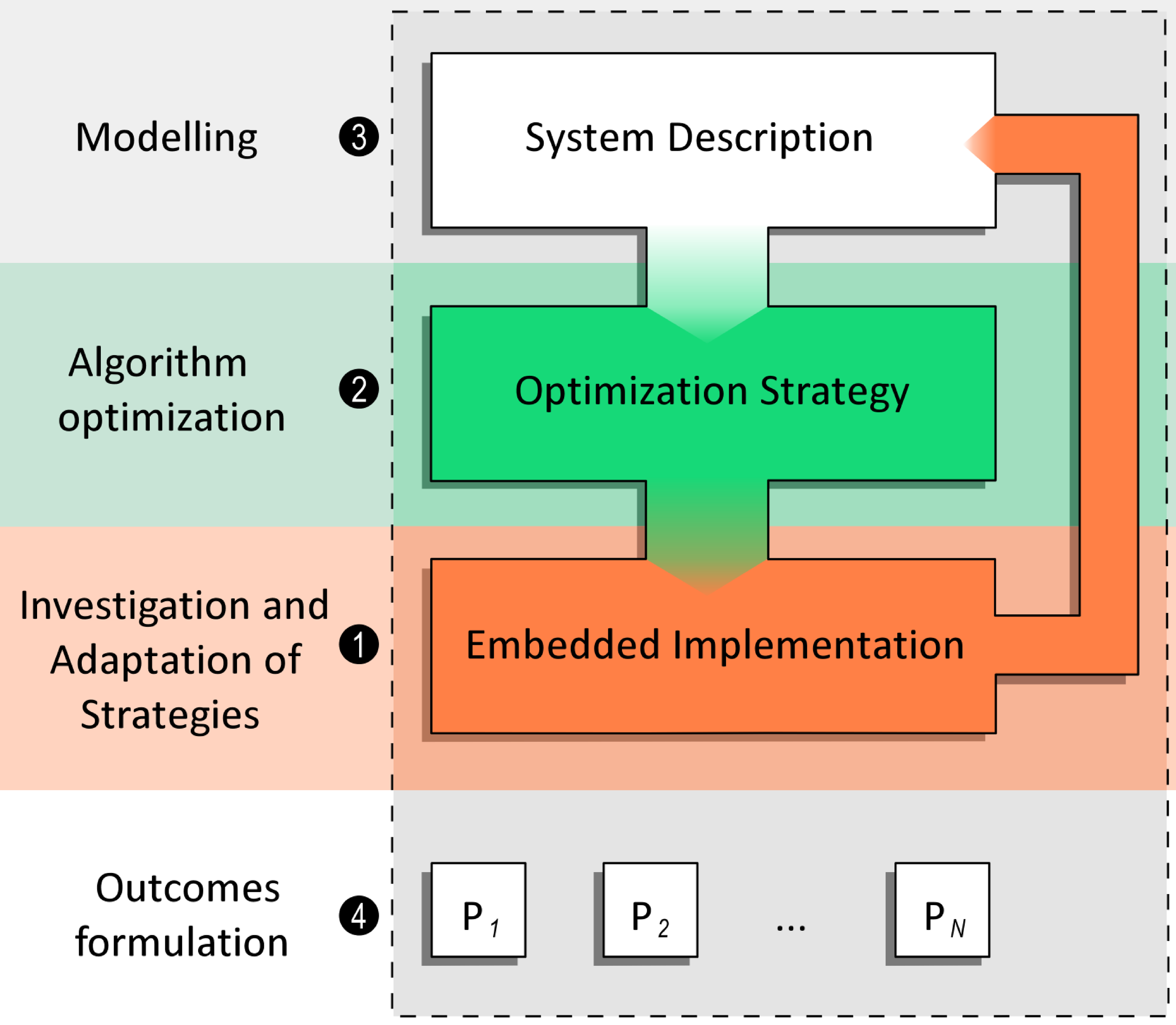
Approach

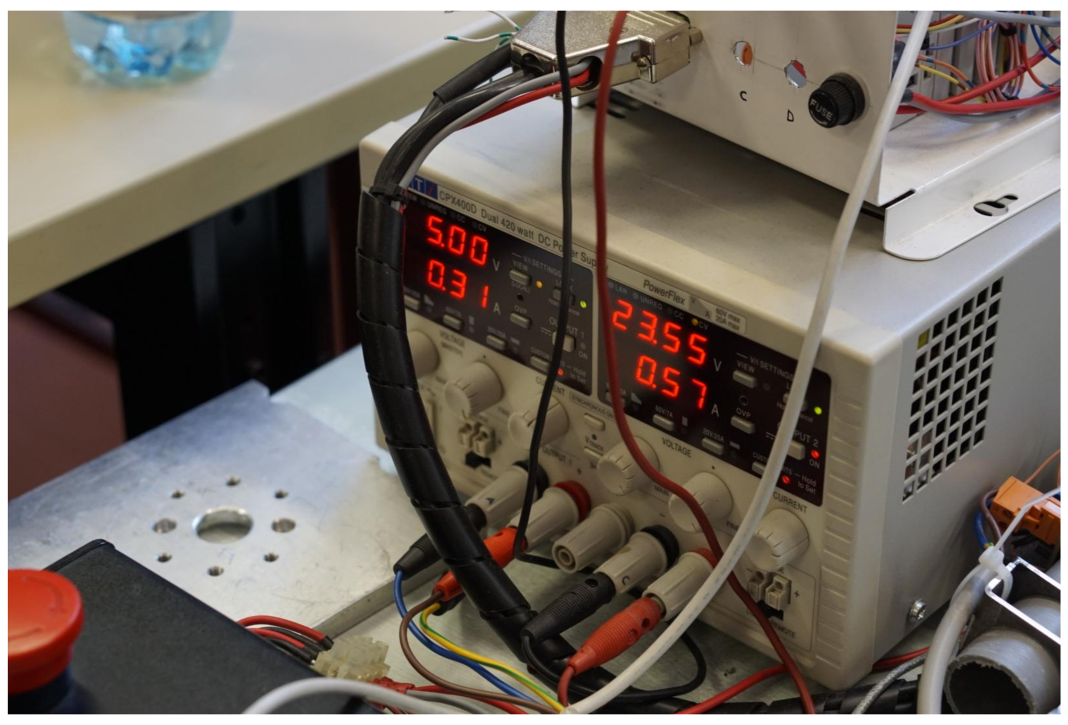
3: **Modelling** – will formalize new models described by mathematical functions (i.e., Ordinary Differential Equations) in order to describe the system's evolution in time, and later, to predict future power consumption. This part will involve machine learning techniques and global optimization strategies.

2: **Algorithm Optimization** – will develop novel techniques by optimizing existing algorithms in order to achieve a better overall power consumption while respecting time and security constraints.

1: **Investigation and Adaptation of Strategies** – will investigate state-of-the-art techniques for Computer Vision, and adapt the algorithms to a Heterogenous Embedded System. This part will be concerned with physical measurements of platforms under analysis, and with the adaptation of the algorithms leading to the drone use case.

4: **Outcomes formulation** – will put together all the parts and will evaluate the general outcomes within a full robotic system.





References

[1] Press release announcing start of TeamPlay. https://teamplay-h2020.eu/index.php?page=press-release. Accessed: 2018-11-24.

[2] Leslie Pack Kaelbling. Learning in Embedded Systems. MIT press, 1993.

[3] Christoforos Kanellakis and George Nikolakopoulos. Survey on Computer Vision for UAVs: Current developments and trends. Journal of Intelligent & Robotic Systems, 87(1):141–168, 2017.