technische universität dortmund

computer science 12

Bachelor/Master Thesis

Investigating Structural Redundancy in Scheduling Allocations

Lars Willemsen
Prof. Dr. Jian-Jia Chen

Otto-Hahn Str. 16
Technische Universität Dortmund
Email: lars.willemsen@tu-dortmund.de
May 21, 2026

Certification based scheduling may call for the use of fully deterministic scheduling behavior that is not supported by the use of scheduling algorithms directly. In such cases, we may want to use *scheduling tables* directly linking time to task allocations without any dynamic arbitration. Currently, such scheduling tables are of prevalent use in e.g. aviation [1].

Figure 1: Certified hardware controllers in aviation

These tables however may, in certain circumstances, be produced by standard scheduling algorithms. Most standard scheduling algorithms produce allocations following a very specific, repeatable pattern. This pattern may recur in the resulting table, leading to a representation that is likely highly *compressible* and therefor desirable to identify.

In this thesis project we are looking specifically at a structure that can be described by an **Arithmetic Progression** (AP). Such a structure is described by a period T, a phase ϕ and a cardinality (the amount of elements):

$$A_i \;=\; \{\, \phi_i + k \cdot T_i \mid k \in \{0, 1, \ldots, n_i - 1\} \,\} \qquad (1)$$

This structure naturally occurs under e.g. preemptive fixed priority scheduling, where the highest priority task is always assigned to the processor upon its release. However, in general, scheduling arbitration may obfuscate, fragment or outright destroy the existence of these structures.

In this thesis,[1] You will be familiarizing yourself with the notion of *timing anomalies*: scheduling oddities that complicate scheduling analysis. Under the existence of such anomalies, we may want to use deterministic tables produced by a set of common scheduling algorithms. During this thesis you will explore several of such algorithms through a provided evaluation framework. The goal of this thesis is to try and identify factors that contribute to the prevalence of AP patterns. When do task allocations behave predictably, and when under what circumstances does this fall apart? Your final thesis should have both experimental and theoretical backing for the results you obtained.

This thesis is also highly amendable to your suggestions and may be steered in the direction of conventional compression if good alternatives are posed.

Required Skills:

- Highly familiar with programming in Python
- Familiarity with how to present results in a formal, mathematical way

Acquired Skills after the thesis:

- You have become familiarized with the notion of timing anomalies and scheduling tables
- You presented a self-guided exploration on structural redundancy in a specific source
- You learned how to present data both through experimentation and formal argument

References:

[1] TTTech Aerospace. https://www.tttech.com/aerospace

[1] Other suggestions and related topics are also welcome. Please do not hesitate to make an appointment.