technische universität dortmund

computer science 12

Master Thesis

Probabilistic Suspension Time

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A classical, hard real-time analysis aims to determine whether tasks fulfill their timing constraints under all circumstances. However, many embedded real-time systems can still function well even with occasional (bounded) deadline misses. For such systems, the probability that a deadline will be missed, the so-called *deadline failure probability* needs to be analyzed.

Our recent result [1] proves that a classical result [2] for probabilistic task systems is actually flawed. Moreover, we provide a correct result assuming that execution times are probabilistic. The current result is however limited to the standard task model without self-suspension. When considering (probabilistic) self-suspension of tasks, the fix should work basically out of the box. However, due to the incorrectness of previous results the extension to self-suspending task has to be rigorously checked.

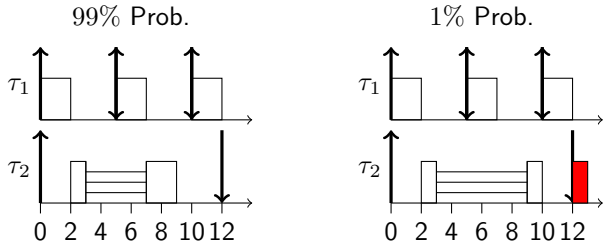

Figure 1: Occasional deadline misses with probabilistic self-suspension behavior. Left: Low suspension with high probability. Right: Long suspension with low probability leads to deadline miss.

In this thesis, the student extends the analysis for tasks with probabilistic execution time [1] to tasks with (probabilistic) self-suspension. To that end, the student migrates the proof from the previous result and carefully checks that the underlying properties necessary for each analysis step still hold. Implementation and evaluation of the proposed solution should be conducted.

Required Skills:

- Knowledgeable about real-time systems.
- Interested in self-suspending tasks.
- Willing to prove and check theoretical properties of real-time systems.

Acquired Skills after the thesis:

- Deep knowledge about self-suspending tasks.
- Ability to work on abstract topics and provide rigorous proofs.

References:

[1] Kuan-Hsun Chen, Mario Günzel, Georg von der Brüggen, and Jian-Jia Chen. "Critical instant for probabilistic timing guarantees: Refuted and revisited." 2022 IEEE Real-Time Systems Symposium (RTSS). IEEE, 2022.

[2] Dorin Maxim, and Liliana Cucu-Grosjean. "Response time analysis for fixed-priority tasks with multiple probabilistic parameters." 2013 IEEE 34th Real-Time Systems Symposium. IEEE, 2013.