Scheduling Self-Suspending Tasks: New and Old Results (Artifact)

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Abstract

In computing systems, a job may suspend itself (before it finishes its execution) when it has to wait for certain results from other (usually external) activities. For real-time systems, such self-suspension behavior has been shown to induce performance degradation. Hence, the researchers in the real-time systems community have devoted themselves to the design and analysis of scheduling algorithms that can alleviate the performance penalty due to self-suspension behavior. As self-suspension and delegation of parts of a job to non-bottleneck resources is pretty natural in many applications, researchers in the operations research (OR) community have also explored scheduling algorithms for systems with such suspension behavior, called the *master-slave* problem in the OR community.

This paper first reviews the results for the master-slave problem in the OR literature and explains their impact on several long-standing problems for scheduling self-suspending real-time tasks. For frame-based periodic real-time tasks, in which the periods of all tasks are identical and all jobs related to one frame are released synchronously, we explore different approximation metrics with respect to resource augmentation factors under different scenarios for both uniprocessor and multiprocessor systems, and demonstrate that different approximation metrics can create different levels of difficulty for the approximation. Our experimental results show that such more carefully designed schedules can significantly outperform the state-of-the-art.

2012 ACM Subject Classification Computer systems organization → Real-time systems

Keywords and phrases Self-suspension, master-slave problem, computational complexity, speedup factors

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Related Article Jian-Jia Chen, Tobias Hahn, Ruben Hoeksma, Nicole Megow, and Georg von der Brüggen, "Scheduling Self-Suspending Tasks: New and Old Results", in 31st Euromicro Conference on Real-Time Systems (ECRTS 2019), LIPIcs, Vol. 133, pp. 16:1–16:23, 2019.
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1 Scope

This artifact supports the paper entitled *Scheduling Self-Suspending Tasks: New and Old Results*. The abstract of the paper is provided above. The artifact allows to rerun the evaluations detailed in Figure 1 and Figure 2 in the paper, i.e., it allows to recreate the complete evaluation results. The figures compare the Largest Suspension First (LSF) algorithm introduced in the paper related to this artifact [1] with the algorithm by Sahni & Vairaktarakis (SV) [2] and SEIFDA [3].

2 Content

The artifact package includes:
- A description on how to run the artifact, providing general information on how to run the evaluation. The source code itself is commented inside the related files.
- The necessary Python source code.
- The version of the related paper published in ECRTS 2019.

3 Getting the artifact

The artifact endorsed by the Artifact Evaluation Committee is available free of charge on the Dagstuhl Research Online Publication Server (DROPS). In addition, the artifact is also available at: `https://ls12-www.cs.tu-dortmund.de/daes/media/documents/ecrts19/artifact.tar`

4 Tested platforms

There should be no specific hardware requirements assuming an in general modern system. For instance, the artifact ran in roughly 1 hour on a system with the following characteristics:
- Lenovo Thinkpad x240 (from 2014)
- Intel i7-4600 CPU at 2.1 GHz
- 8 GB main memory
- 32KB/256KB/4MB of L1/L2/L3 Cache

Software requirements are an installation of Python 2.7, including the packages *numpy*, *matplotlib*, and *sympy*. Some details on how to get python and the necessary packages for Windows, Linux, and MacOS can be found in the provided instructions.

5 License

6 MD5 sum of the artifact

bd6f6c7485f8985fd74d05a44782ef47

7 Size of the artifact

1.2 MB

References

1 Jian-Jia Chen, Tobias Hahn, Ruben Hoeksma, Nicole Megow, and Georg von der Brüggen. Scheduling Self-Suspending Tasks: New and Old Results. In *Proceedings of the 31st Euromicro Conference on Real-Time Systems (ECRTS 2019)*, 2019.

2 Sartaj Sahni and George L. Vairaktarakis. The master-slave paradigm in parallel computer and industrial settings. *J. Global Optimization*, 9(3-4):357–377, 1996.

3 Georg von der Brüggen, Wen-Hung Huang, Jian-Jia Chen, and Cong Liu. Uniprocessor Scheduling Strategies for Self-Suspending Task Systems. In *Proceedings of the 24th International Conference on Real-Time Networks and Systems, RTNS 2016, Brest, France, October 19-21, 2016*, pages 119–128, 2016.