Empirical Evaluation of a Domain-Specific Language for High-Performance Marine Ecosystem Simulation

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Abstract: In this paper, we report on the empirical evaluation of domain-specific languages by evaluating the Sprat Ecosystem DSL for its effectiveness and efficiency.

Keywords: Domain-specific language; Model-driven software engineering; Empirical evaluation

1   Introduction

In science and research, we observe an increasing use of software. Often scientific experiments are conducted in virtual research environments with computer-based simulations, which are typically implemented by the scientists themselves. Traditionally, these research software engineers employ no or only few software engineering methods and techniques while developing large simulation software systems. Therefore, specific software support is required to efficiently enable such scientific work [JH18].

Domain-specific languages (DSL) are usually employed for model-driven software engineering in specific domains such as railway systems [Go12], software performance engineering [BH09; Vö16] and software modernization [Ho11].

Sprat is a DSL for specifying high-performance marine ecosystem simulation experiments [JH14a; JH14b; Jo16; Jo17]. We report on an online survey including controlled experiments to compare the correctness and the time spent of experts from the domain of ecosystem simulation in solving typical ecosystem simulation specification tasks with our DSL and with a GPL-based solution [JH17]. By measuring correctness scores and time spent on the assignments, we evaluate the effectiveness and efficiency of the Sprat Ecosystem DSL. The findings provide empirical evidence that the Sprat DSL can indeed increase the productivity of scientific software developers, who often have no formal software engineering training. Our results show that the domain experts achieve significantly higher accuracy and spend less time when using our DSL instead of the comparable GPL-based solution.

Our study extends the relatively scarce body of existing evaluation research on DSL to a scientific domain with users often not specifically trained in programming and software

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engineering techniques. While the participants of many previous experiments are students, our subjects are professionals from the domain.

Literatur

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