Authoring Verified Documents by Interactive Proof Construction and Verification in Text-Editors

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Abstract Aiming at a document-centric approach to formalizing and verifying mathematics and software we integrated the proof assistance system ΩMEGA with the standard scientific text-editor TEXMACS. The author writes her mathematical document entirely inside the text-editor in a controlled language with formulas in LATEX style. The notation specified in such a document is used for both parsing and rendering formulas in the document. To make this approach effectively usable as a real-time application we present an efficient hybrid parsing technique that is able to deal with the scalability problem resulting from modifying or extending notation dynamically. Furthermore, we present incremental methods to quickly verify constructed or modified proof steps by ΩMEGA. If the system detects incomplete or underspecified proof steps, it tries to automatically repair them. For collaborative authoring we propose to manage partially or fully verified documents together with its justifications and notational information centrally in a mathematics repository using an extension of OMDOC.

1 Introduction

Unlike widely used computer-algebra systems, mathematical assistance systems have not yet achieved considerable recognition and relevance in mathematical practice. One significant shortcoming of the current systems is that they are not fully integrated into or accessible from standard tools that are already routinely employed in practice, like, for instance, standard mathematical text-editors. Integrating formal modeling and reasoning with tools that are routinely employed in specific areas is the key step in promoting the use of formal logic based techniques.

Therefore, in order to foster the use of proof assistance systems, we integrated the theorem prover ΩMEGA [7] into the scientific text-editor TEXMACS [15]. The goal is to assist the author inside the editor while preparing a TEXMACS document in a publishable format. The vision underlying this research is to enable a document-centric approach to formalizing and verifying mathematics and software. We tackle this vision by investigating two orthogonal approaches in parallel: On the one hand we start with mathematical documents written without any restrictions and try to extract the semantic content with natural language analysis techniques and accordingly generate or modify parts of the document using natural language generation. On the other hand we start with the semantic content and lift it to an abstract human-oriented representation without losing the benefits of machine processability. This paper describes our recent results for the second approach, resulting in a system in which the author can write a document