

Report on the outcomes of a Short-Term Scientific Mission¹

Action number: CA20111

Grantee name: Julie Cailler

Details of the STSM

Title: Expansion of the Goéland Theorem Prover and Interoperability with the LISA Proof Assistant

Start and end date: 19/02/2024 to 01/02/2024

Description of the work carried out during the STSM

Description of the activities carried out during the STSM. Any deviations from the initial working plan shall also be described in this section.

(max. 500 words)

We have developed a standardized format for representing sequent-based calculus in TPTP. This format serves as an extension of the TPTP format, accommodating both one and two-sided sequent calculus (such as tableaux and GS3). In the design process, we conducted a thorough analysis of existing derivation formats within TPTP. It results in the SC-TPTP format, which is able to specify the allowable derivation steps for these types of derivations. The current iteration supports typical propositional and first-order rules, alongside functionalities for cuts, substitutions, weakenings, transformation into negation normal form, and an initial version of equality reasoning.

Furthermore, we have enhanced the Goéland theorem prover to produce proofs in the SC-TPTP format. These improvements include managing axiom dependencies and handling two-sided proofs effectively.

Additionally, we have expanded the capabilities of the Lisa proof assistant to facilitate the export, import, and verification of proofs in the SC-TPTP format. As part of this extension, we integrated Goéland as a proof-producing tactic within Lisa. This integration enables seamless communication between both tools, allowing for automated proof exchange and verification.

Description of the STSM main achievements and planned follow-up activities

¹ This report is submitted by the grantee to the Action MC for approval and for claiming payment of the awarded grant. The Grant Awarding Coordinator coordinates the evaluation of this report on behalf of the Action MC and instructs the GH for payment of the Grant.

Description and assessment of whether the STSM achieved its planned goals and expected outcomes, including specific contribution to Action objective and deliverables, or publications resulting from the STSM. Agreed plans for future follow-up collaborations shall also be described in this section.

(max. 500 words)

This project was closely related to another application, with the ultimate goal of developing a tool capable of taking SC-TPTP as input and generating proofs in various proof assistant formats. The work carried out during this initial STSM was executed according to the outlined plan. By designing a general format for sequent-based calculus and facilitating the exchange of proofs between Goéland and Lisa, we contributed to the memorandum of understanding (MoU) "Promote the output of detailed, checkable proofs from automated theorem provers".

Our next objectives are to expand the format to include extended deduction steps (such as more detailed equality reasoning, types management, etc.) and to enable the translation of SC-TSTP into other proof assistant formats (such as Coq, LambdaPi, etc.). Additionally, we plan to enhance the Princess automated theorem prover to allow it to produce SC-TPTP proofs, thereby broadening the scope of the format. Our ultimate aim is to provide a standard for sequent-based proof output, facilitating easy verification. Concurrently, we are working on a paper that comprehensively describes the format.

In the professional and social domain, the applicant and their coworker have established productive collaborations, benefiting from each other's expertise and that of their respective supervisors. Moreover, both applicants are junior researchers, one being a PhD student and the other a recently graduated postdoctoral researcher. Hence, this STSM aligned with the MoU objectives of "Bring together members of the different communities working on proofs in Europe", "Create an excellent and inclusive network of researchers in Europe with lasting collaboration beyond the lifetime of the Action" and "Actively supporting young researchers, the underrepresented gender, and teams from regions with less capacity."