

Report on the outcomes of a Short-Term Scientific Mission¹

Action number: CA20111

Grantee name: Aarne Ranta

Details of the STSM

Title: Informalization and Autoformalization with Dedukti and GF

Start and end date: 09/04/3025 to 16/04/2025

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)

Ranta visited the Dedukti team at ENS Saclay as planned. He had a desk in the same corridor as the group and was in contact with the group members several times on each working day.

On the first full day of his visit, 10 April, Ranta gave a talk introducing the Informath project and the usage of GF and Dedukti. The talk was attended by about 20 persons on campus and 10 remotely. It provided a common ground for continued discussions about the questions that were planned to be addressed.

Helped by Frédéric Blanqui and his staff members, Ranta got access to an extensive material of Dedukti formalizations, in particular from HOL-light and Lean. The latter was also a stress test to the Lean to Dedukti algorithm under development by Rishikesh Hirendu Vaishnav in the Dedukti group. Ranta started testing with the informalization of these resources and got everything needed for continuing the work after his return.

In addition to the mathematical library resources, Ranta expected to learn more about the treatment of hidden arguments and their reconstruction. It turned out that this can be solved by a communication between Dedukti and Lambdapi, where Lambdapi can specify and restore hidden arguments and export them to Dedukti.

A third, initially unexpected, development was the use of Dedukti's rewrite rules when converting between different formalisms. This technique, available as "dk meta", can simplify the current algorithms in Informath significantly. Some issues were identified to make this method fully applicable.



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 of the STSM main achievements and planned follow-up activities

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)

The goals planned in the STSM application were achieved as follows:

- translations between Dedukti and other formal systems X,
 - ideas were exchanged about the ongoing work on both sides (Dedukti and GF), and the use of Dedukti's rewrite rules on a "meta" level was identified as a promising method
- usage of libraries available in Dedukti format
 - extensive libraries from HOL-light and Lean were exported and initial informalizations generated; completing the work is a major project that is continuing after the visit
- mechanisms for hiding and restoring information:
 - this problem got a clear solution from the convertibility between Dedukti and Lambdapi

The addressed Action objectives were advanced as follows:

Research Coordination Objectives

6 Develop the use of artificial intelligence and machine learning techniques on proofs.

- during the STSM, the dataset for synthesizing language data from math libraries was extended substantially

8 Develop the use of natural or controlled languages in proof systems.

 this main objective of the Informath project was advance and also connected to other approaches, in particular the ERC synergy project Malinca, whose PIs Philippe de Groote and Paul-André Mellies came to Saclay to listen to Ranta's talk and discuss with him

Capacity building objectives

1 Bring together members of the different communities working on proofs in Europe.

 The contacts between GF and Dedukti were strengthened, a contact with the Malinca project was established, and Ranta's talk on 10 April was followed by members of several communities.

4 Ease access to formal verification techniques in education and other areas of science.

- The set of mathematical concepts covered by formal-informal conversion was extended

6 Transfer knowledge in terms of expertise, scientific tools and human resources across the different disciplines and between academia and industry.

- The Informath project connects the formal proof community with the linguistic community.
- It also builds on the experience from using GF and formal proofs industrial projects

Planned future activities:

- Ranta's future collaboration with the Dedukti team; next visit in September 2025
- collaboration with the Malinca project; planned visit in July 2025 in Paris or Nancy, and a workshop in Gothenburg later

Host: Frédéric Blanqui 23/04/25

Grantee enters max 500 word summary here.

PAGE * MERGEFORMAT 3