

Short-Term Scientific Mission Grant - APPLICATION FORM¹ -

Action number: CA20111

Applicant name: Horatiu Cheval

Details of the STSM

Title: Domain theory for program verification in Lean

Start and end date: 10/06/2024 to 15/06/2024

Goals of the STSM

Purpose and summary of the STSM.

(max.200 word)

Our goal is to continue the work we started in a previous STSM, where I visited Vlad Rusu in Lille, which led to the beginning of our collaboration and of a Lean formalization of coinduction and partial (co)recursive functions, based on domain theory. This work was already concretized in a submitted paper [1].

[1] Horatiu Cheval, David Nowak, Vlad Rusu. Formal Definitions and Proofs for Partial (Co)Recursive Functions. 2023. [\(hal-04360660v2\)](#)

Working Plan

Description of the work to be carried out by the applicant.

(max.500 word)

We intend to have daily meetings between David Nowak, Vlad Rusu and I, in which we will discuss the current status of our implementations and of the theory we have developed. In the paper [1] that resulted from the previous visit, we lay out future research directions, and we intend to discuss and start working on them during this visit. Among the topics we want to investigate are: the implementation of general finite partial containers in Lean, adapting our theory to support mutually inductive-coinductive types, and the implementation of a user-friendly interface for defining and working with non-native coinductive types in Lean. We will also compare the Lean development to a parallel Coq implementation that David Nowak and Vlad Rusu are creating in Lille.

[1] Horatiu Cheval, David Nowak, Vlad Rusu. Formal Definitions and Proofs for Partial (Co)Recursive Functions. 2023. [\(hal-04360660v2\)](#)

¹ This form is part of the application for a grant to visit a host organisation located in a different country than the country of affiliation. It is submitted to the COST Action MC via e-COST. The Grant Awarding Coordinator coordinates the evaluation on behalf of the Action MC and informs the Grant Holder of the result of the evaluation for issuing the Grant Letter.

Expected outputs and contribution to the Action MoU objectives and deliverables.

Main expected results and their contribution to the progress towards the Action objectives (either research coordination and/or capacity building objectives) and deliverables.

(max.500 words)

The STSM will help continue the work we started in my previous STSM in Lille with David Nowak and Vlad Rusu. Concrete outputs will be a new implementation in the Lean theorem prover of coinduction based on domain theory. We currently have a work-in-progress implementation, but this will be extended with a mechanism that hides the implementation details from users, allowing one to use coinductive types and partial (co)recursive functions as if they were native to the Lean language. This is crucial for the wider adoption of our system in the Lean community. We will also formalize novel theoretical notions, like finite partial containers. As the previous STSM, this ties into deliverable D8 of the action.