Short-Term Scientific Mission Grant
- APPLICATION FORM[1] -

Action number: CA20111

Applicant name: Miguel Ramos

Details of the STSM

Title: Quantitative types for higher-order programming languages with effects

Start and end date: 13/01/2025 to 22/01/2025

Goals of the STSM

Purpose and summary of the STSM.

(max.200 word)

The purpose of this short-term mission is to continue ongoing work on using quantitative types for developing resource aware semantics for higher-order programming languages with effects. More specifically, on developing resource aware semantics for a call-by-push-value (CBPV) language with global state. Recently, we have been successful in doing so for call-by-value (CBV) and call-by-name (CBN) languages with global state. This work aims at extending these results to a subsuming framework.

Working Plan

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

(max.500 word)

Since the purpose of this mission is to continue ongoing work, the exact plan is subject to change depending on its stage of development at the time of the visit. Regardless, the current plan is the following. We have decided to use the bang-calculus as our unifying framework due to its close connection with linear logic, thus:

- The first part of the plan is to understand how to extend the operational semantics of the bang-calculus with the standard notion of global state. To do this, we will follow the same approach as in our previous work on CBV and CBN languages with global state. We will extend the term syntax of the bang-calculus with the standard algebraic operations for global, choose an appropriate notion of state, and consider an operational semantics over configurations (i.e. term-state pairs).
- The second part of the plan is to understand how to extend the relational model of the bang-calculus by considering the alterations introduced in the previous step. To do this, we will again

[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.

follow the same approach as in our previous work CBV and CBN languages with global state. We will introduce an appropriate notion of type for states and lift the notion of type for terms by considering the monadic structure induce by the algebraic theory of global state.

- The final part of the plan is to write a research paper based on the results obtained in the two previous parts. Some of the expected results are: a strong operational semantics for a call-by-push-value language with global state, together with a sound and complete syntactical characterization of normalization; a sound and complete relational model for a call-by-push-value language with global state that, not only characterizes termination, but is also resource-aware, and is thus able to measure quantitative properties related to time (evaluation steps) and memory use (locations on global state).

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)

We believe that the work that is to be developed during this mission is aligned with the objectives of WG3 and WG6 of the action. Regarding program verification (WG3), we believe that by providing a relational model (via a non-idempotent intersection types) for a call-by-push-value language with global state, we are contributing to the resource-aware verification of languages with effects and, by simply considering idempotent intersection types instead, it is also arguable that we are contributing towards the recent state-of-the-art use of intersection types for model checking higher-order languages with effects. Recent results by Gavazzo et al. (2024) provide a generic framework for algebraic effects that can be used for model checking; however, their work is based on a CBV language with a restricted syntax and does not capture global state. Regarding type theory (WG6), we believe that our relational model (non-idempotent type system) can be seen as a contribution towards to the development of effectful type theories.