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

Action number: CA20111

Applicant name: Violet Ka I Pun

Details of the STSM

Title: Developing a graded type system for a resource-aware workflow modelling language

Start and end date: 17th – 26th February 2025 (10 days)

Detail of the cost in EUROS:

As reference, you can use the daily allowances by country for ITCGs (https://europroofnet.github.io/itcg-daily-allowance/) and the associated Excel sheet (https://europroofnet.github.io/_pages/grant.xlsx).

- Transport (upload screen capture): €448,70

- Hotel/day (upload screen capture): €159,56

- Food/day: €60,44

TOTAL: €2648,70

Goals of the STSM

Business process workflows can be intricate to model and analyse, especially if they are composed of multiple concurrent workflows running across different departments or organisations. Such workflows are very often dependent on each other through, for example, shared resources, which can easily lead to bottlenecks that hinder workflow progression.

The goal of this STSM is to develop a type system based on graded modal types for a resource-aware workflow modelling language, on which a framework can be built for modelling and analysing business process workflows with concurrent access to shared resources.

This STSM supports a recently established collaboration between **the applicant** (**Violet Ka I Pun**, Western Norway University of Applied Sciences (HVL), Bergen, Norway), and **the host** (**Elena Zucca**, DIBRIS, University of Genova) on formal modelling and analysis for workflow models using graded types. This collaboration also include **Francesco Dagnino** from the host institution and **Paola Giannini** from the University of Eastern Piedmont as well as **Ulises Nicolás Torrella** from HVL, who will be doing his research stay at the host institution for his PhD study.

Working Plan

During this visit, we plan to concretise the idea of developing a type system based workflow modelling framework. We intend to formalise the concept by means of operational semantics and a type system to guarantee proper use of consumable resources for business process workflows in medium to large organisations. We plan to develop such formalisation by leveraging the recent research [1, 2] by the

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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.

collaborators at the host institution, which uses graded modal type theory to ensure resource-aware soundness for a lambda calculus, as well as the knowledge of resource aware workflow modelling from HVL.

Thus, this STSM is going to take place in the context of the development of a workflow modelling framework, focusing on the implementation of a type system that will perform a static analysis over the use of consumable resources shared among concurrent workflows. Our plan is to first investigate the possibility of adopting graded type systems in the context of concurrent workflow models, then to integrate the theoretical findings into our workflow modelling framework so as to provide a formalisation on the consumption of resources, by enforcing a balanced and sustainable use. The development of the type system is planned to be gradual on the complexity and completeness of resource aware concepts. This gradual progress can be described in intermediate type systems that allow for a certain grade of resource consumption verification under parallelism.

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

Main expected results and their contribution to the progress towards the Action objectives (https://europroofnet.github.io/objectives/) and deliverables (https://europroofnet.github.io/deliverables/).

Working groups to which this mission contributes:

One expected result of the STSM is a better understanding on how type theory, in particular graded modal types, can be used to analyse resource allocation in the domain of business process management. We expect such an understanding would eventually contribute to the theoretical development of a graded type system which is intended to be used to analyse and validate workflows modelled in the form of concurrent systems with an active object language. One could consider such a type system as a powerful verification tool enforcing mathematical correctness of workflow models in terms of resource manipulation. As a consequence, the ultimate result of this STSM could contribute to making type theory, formal proofs and program verification techniques more accessible in the domain of business process management, thus, contributes to **Capacity Building Objectives (CBO) 4**.

Also, this STSM brings together members from the communities of type theory (the host) and formal modelling and analyses (the applicant); thus, contributing to **CBO 1**.

In addition, as said in the working plan, this STSM takes place in a bigger context of developing a workflow modelling framework, in which the to-be-developed graded type system would be used as a verification tool for workflow models, which could potentially contribute to deliverable **D15**.

Furthermore, the proposed research is relevant to **Working Group 3** on Program verification and **Working Group 6** on Type theory.

References

[1] Riccardo Bianchini, Francesco Dagnino, Paola Giannini, Elena Zucca: Multi-Graded Featherweight Java. ECOOP 2023: 3:1-3:27. https://doi.org/10.4230/LIPIcs.ECOOP.2023.3

[2] Riccardo Bianchini, Francesco Dagnino, Paola Giannini, Elena Zucca: Resource-Aware Soundness for Big-Step Semantics. Proc. ACM Program. Lang. 7(OOPSLA2): 1281-1309 (2023). https://doi.org/10.1145/3622843