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

Action number: CA20111

Applicant name: M. Chase Ford

Details of the STSM

Title: Algorithmic foundations of graded coalgebraic semantics

Start and end date: 23/03/2025 to 29/03/2025

Detail of the cost in EUROS:

- Transport (upload screen capture): 178

- Hotel/day (upload screen capture): 150

- Food/day: 40

TOTAL: 1318

Goals of the STSM

This STSM aims to initiate a research programme on the algorithmic foundations of graded coalgebraic semantics, a generic framework for capturing notions of process semantics along the linear-time branching-time spectrum on the level of coalgebras [1,2,3,4,5]. This builds directly on existing collaborations between the applicant (M. Chase Ford), host (Lutz Schröder), and their collaborators (Stefan Milius, Harsh Beohar, and Barbara König) [2,4] where a game-theoretical characterization of graded semantics is described. This leads to a generic and uniform fixed-point characterization of a wide variety of notions of process equivalence, yet further developments on this observation have been neglected until now. We intend to pursue this idea further with the goal to develop a robust fixed-point theory of graded semantics that goes beyond equivalences (e.g. preorders and distances) with winning strategies in graded behavioural equivalence games as our starting point.

As a secondary objective of this STSM, we plan to incorporate our insights into the design of generic tools for equivalence checking and minimization of systems under graded semantics. Such tools would significantly increase the expressive power of their existing coalgebraic analogues by enabling the choice of a graded semantics as an additional parameter.

[1] U. Dorsch, S. Milius, and L. Schröder. "Graded monads and graded logics for the linear time - branching time spectrum". In Concurrency Theory, CONCUR 2019, vol. 140 of LIPIcs, pp. 36:1–36:16. Schloss Dagstuhl - Leibniz-Zentrum für¨ Informatik, 2019.

[2] C. Ford. "Presentations of graded coalgebraic semantics". PhD thesis, Friedrich-Alexander-Universität Erlangen-Nürnberg, 2023.

[3] C. Ford, S. Milius, and L. Schröder. "Behavioural preorders via graded monads". In: Logic in Computer Science, LICS 2021, pp. 1–13. IEEE, 2021.

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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.

[4] C. Ford, S. Milius, L. Schröder, H. Beohar, and B. König. "Graded monads and behavioural equivalence games". In Logic in Computer Science, LICS 22. ACM, 2022.

[5] S. Milius, D. Pattinson, and L. Schroder. Generic trace semantics and graded monads. In: Algebra and Coalgebra in Computer Science, CALCO 2015, vol. 35 of LIPIcs, pp. 253–269. Schloss Dagstuhl - Leibniz-Zentrum fur Informatik, 2015.

(max.200 word)

Working Plan

Realistically, one week is not enough time to fully realize both our primary and secondary objectives. Instead, we will utilize our project period to establish technical developments towards our primary objective (fixed-point computations of graded semantics), and to establish a plan for pursuing our secondary objectives. To this end, we will hold daily meetings between the applicant (M. Chase Ford) and host (Lutz Schröder) along with other local experts based at the host institution (Stefan Milius, Jonas Forster, Henning Urbat, Thorsten Wißmann, and Paul Wild). The applicant expects that the host will be capable of devoting half of each day to their dedicated collaboration sessions, while the remaining time will be spent in collaborative sessions with the other local experts of the host institute.

(max.500 word)

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

Our research aligns with WG3 ("Program verification"): we aim to initiate studies on the algorithmic foundations of graded coalgebraic semantics that we envision as the first step towards the design of novel verification and reasoning tools which are generic in the choice of a system type (e.g. non-deterministic or probabilistic) and semantics (e.g. branching-time or trace semantics). This contributes to WG3's aim "to lower the computational complexity and increase expressiveness of techniques for the verification of program correctness".

We also expect to develop a concrete plan for the next steps in our research programme as well as documenting our fresh insights in a paper that we will submit to a relevant computer science conference (e.g. ETAPS or LICS). The former contributes to Capacity Building Objective 3 ("Create an excellent and inclusive network of researchers in Europe with lasting collaboration beyond the lifetime of the action") by reinforcing existing ties between Leiden University and Friedrich-Alexander-Universität Erlangen-Nürnberg, while the latter contributes to Capacity Building Objective 8 ("Disseminate the results of the Action activities to the scientific community, the industry, the certification bodies, the European institutions and to the general public").

We further view this STSM as an opportunity to contribute to Capacity Building Objective 1 ("Bring together members of the different communities working on proofs in Europe"), Objective 5 ("Actively support young researchers, the under-represented gender, and teams from regions with less capacity"), and Objective 7 ("Prepare competitive EU researchers for a fruitful career in an international environment through intensive use of Short Term Scientific Missions (STSM) and joint educational programs with industry") by enabling the applicant to further cement existing connections in Erlangen while engaging in new lines of research.

Working groups to which this mission contributes:

WG3 (Program Verification)

(max.500 words)