

The background of the slide is a scenic view of Rhodes, Greece. On the right side, there is a large, ancient stone temple with several tall columns. The temple is built on a rocky hillside. In the background, there is a deep blue sea and a clear blue sky. The overall scene is bright and sunny.

DisCoRail'21 @

ISoLA₂₀₂₁

CO-LOCATED EVENTS
STRESS - RERS



OCT 17 – OCT 29,
2021
RHODES, GREECE



Formal methods for DIStributed COmputing
in future RAILway systems (~~DisCoRail 2020~~)
2021

A track of
International Symposium on Leveraging Applications of Formal Methods
(ISoLA 2021)

Alessandro Fantechi, Stefania Gnesi, Anne Haxthausen



Distributed Computing in Future Railway Systems

- Although naturally constituting a *geographically distributed system*, railways are currently not exploiting the full potential of *distributed computing* for what concerns signalling and control
- Control decisions are usually taken at *centralized boxes* with *centralized logics* which receive data from peripheral sensors and computers.
- *Main driver: conservativeness w.r.t. safety certification: centralisation of responsibility helps certification.*

Distributed Computing in Future Railway Systems

- Advances in the control concepts can indeed exploit the best of distributed computing technologies, promising:
 - *optimization of transport capacity,*
 - *reduction of operational costs.*
- Dynamic network connection among mobile components, decisions are actually taken in a distributed fashion.
- Safety certification in such a dynamic picture calls for a definitely stronger help from Formal Methods

DisCoRail - history

two tracks of past ISOLA conferences on adoption of formal methods in railway signalling:

- “Formal Methods for Intelligent Transportation Systems” ISOLA 2012
- “Formal Methods and Safety Certification: Challenges in the Railways Domain”
ISOLA 2016
- “First International Workshop on Distributed Computing in Future Railway Systems (DisCoRail 2019)”,
 - co-located with @ Federated Conference on Distributed Computing Techniques (DisCoTec 2019) in Lyngby, Denmark, was
 - Aim: *discussing how distributed computing can change the railway signalling domain, with support from formal methods*
 - 12 presentations and discussions between experts from industry and academia.

2021 Contributions

- *10 presentations*
- *in the form of papers and abstracts, published in the two volumes LNCS 12478 and LNCS 13036*
- *In the fields of distributed interlocking systems, standardization of interfaces, advances of current train control systems, and their formalization*
- *With contributions coming from specific projects – either Shift2Rail or national ones*

Program

9:00-10:30: Session 1: Distributed interlocking (chair: Alessandro Fantechi)

J. Peleska: New Distribution Paradigms for Railway Interlocking.

S. Geisler, A. E. Haxthausen: Model Checking a Distributed Interlocking System Using k-induction with RT-Tester.

P. L. Laursen, V. A. Thi Trinh, A. E. Haxthausen: Formal Modelling and Verification of a Distributed Railway Interlocking System Using UPPAAL

11:00-12:30: Session 2: Project Reports (chair: Thierry Lecomte)

F. Flammini and V. Vittorini: RAILS: Roadmaps for AI integration in the rail Sector

S. Chadwick, P. James, F. Moller, M. Roggenbach, and T. Werner: A Journey through Software Model Checking of Interlocking Programs

M. Bartholomeus, R. Erkens, B. Luttik, and T. Willemse: Supporting the Development of Hybrid ERTMS/ETCS Level 3 with Formal Modelling, Analysis and Simulation

M. Bouwman, B. Luttik, A. Rensink, M. Stoelinga, and D. van der Wal: Formal Methods in Railway Signalling Infrastructure Standardisation Processes

14:30-16:00: Session 3: Design of advanced train control systems (chair: Anne Haxthausen)

D. Basile, M. H. ter Beek, A. Fantechi, A. Ferrari, S. Gnesi, L. Masullo, F. Mazzanti, A. Piattino, D. Trentini: Designing a Demonstrator of Formal Methods for Railways Infrastructure Managers.

T. Lecomte, M. Comptier, J. Molinero Perez, D. Sabatier: Ensuring Safety with System Level Formal Modelling.

S. Collart Dutilleul, P. Bon: A Modular Design Framework to Assess Intelligent Trains.

16:30-18:00: Session 4: Discussion

underlined: speaker, bold: remote

Session 4: Discussion (a half hour...)

- *The presentations have shown very diverse approaches to exploiting distribution and formal methods in railway research and industry*
- *Which direction looks most promising to you?*
- *How much impact do you think the massive introduction of some of these approaches will have on future railway systems?*
- *Which approach did you actually like more?*
- *AND:*
- *Should we meet again for DisCoRail 2023?*