Preface

The pervasiveness and efficiency of rail-based transportation infrastructures is generally and justifiably perceived as one of the most evident signs of civilization of a territory. In fact, those systems are able to move a large mass of people through urban or country areas with a high level of safety with respect to road transportation, and a reduced environmental impact due to electrical traction and possible underground operation.

In order to make the safety of rail transportation less dependent on human supervision, that is unfortunately error-prone as witnessed by the many tragic accidents happened in the (even recent) past, computer-based control systems are being increasingly adopted for automatic train protection and operation. In the most advanced of those systems, radio-signalling is employed, allowing on-board systems to receive information about their movement authority and speed profiles using data packets sent over wireless networks, like GSM or Wi-Fi (e.g. in CBTC, Communication Based Train Control). We are talking about control systems which belong to the category known as ‘real-time safety-critical’, since information integrity and timeliness is essential to prevent catastrophic failures, that is serious consequences on the health of human-beings and/or on the environment. Also, mass-transit systems, railways, and metros are attractive targets for criminals and terrorists, and therefore need to be protected even against intentional threats.

In such a context, this book provides engineering students and professionals with a collection of state-of-the-art methodological and technological notions to support the development and certification of railway control systems as well as the protection of rail transportation infrastructures.

To that aim, this book surveys the following main topics in the railway transportation domain:

1. **Regulations and Certification Standards**: Covering both Positive Train Control (PTC) and European Train Control System (ETCS).
2. **Hazard Analysis and Model-Based Evaluation**: Including qualitative, semi-quantitative and quantitative approaches to risk and dependability assessment.
3. **Verification and Validation**: Including interoperability testing, fault-injection and electromagnetic testing.
4. **Automation in Development and Testing**: Addressing frameworks for auto-programming and self-testing.
5. **Formal Methods**: For the verification of railway control logics and the symbolic model-checking of interlocking systems.
6. **Human Factors**: Addressing the usability of machine interfaces and the study of human-barriers.
7. **Security, Monitoring and Surveillance**: Whose concepts and technologies are applied to mission-critical railway equipment and transportation infrastructures.
8. **Experiences and Case-Studies**: Addressing some relevant development and maintenance applications of level-crossing and train control systems.

I believe the topics listed above represent a comprehensive picture of engineering best-practices in the railway domain. As such, they should be part of the technical background of engineers involved in the reliability, safety, and security assurance of railway control systems and infrastructures.

Finally, I would like to thank all the outstanding researchers and professionals who have decided to invest part of their valuable time to contribute to the preparation and to the review of this manuscript.

*Dr. Francesco Flammini*

*Book Editor*