Rail
student

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WINNER

N. project: L1-100 — **category:** **Rail**

Members: Zi Qian — **University:** University of Newcastle Upon Tyne

RA5 — **Safe, Secure and Resilient Transport Systems**

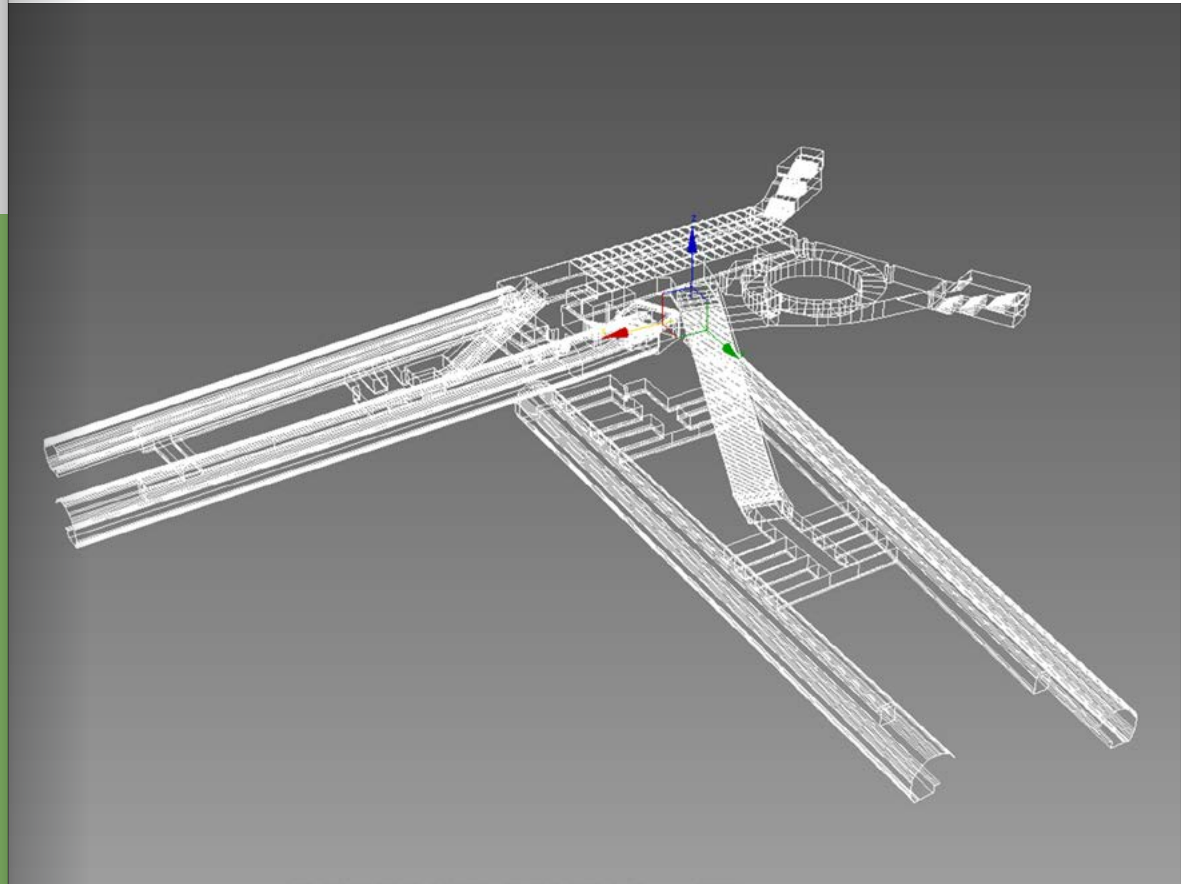
Key Characteristics: There is tremendous potential danger once a fire occurs in a subway system or a tunnel • 3D Computational Fluid Dynamic models developed to validate field measurements and to gain an understanding of the internal airflow momentum and energy transfer capacity of subway stations. •

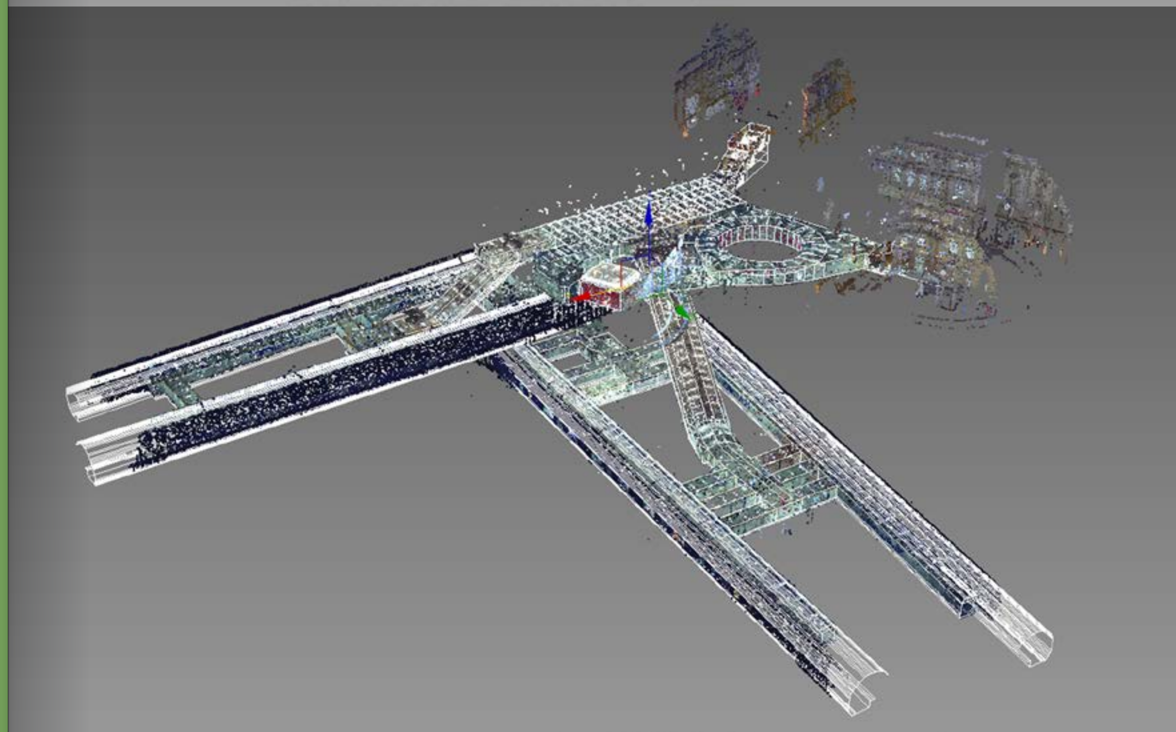
Subway Climatology

The world's first underground line opened on 10th January, 1883, in London to cope with population growth and increasing traffic congestion.

Underground railway systems have become one of the important facilities of urban transportation however there is tremendous potential danger once a fire occurs in a subway system or a tunnel. These types of fires have some distinctive characteristics such as complicated burning process, rapid spread and high temperatures that disperse smoke very quickly. This creates evacuation problems in narrow and enclosed underground station passages. For this reason, understanding how subway tunnels perform during accidents or malicious attacks resulting in the release of smoke or hazardous toxins is key in establishing evacuation strategies that may reduce the loss of lives or effects on public health. During such emergency situation, the natural background air current caused by the air exchange between the station and outside, has an important influence on the dispersion of smoke and/or toxic agents. Over 60% of deaths in fires are caused either wholly or partially by inhalation of smoke or toxic gases. Thus evacuation strategies that provide routes which reduce the exposure time of individuals to a toxic environment could potentially reduce the loss of life or effects on an evacuee's health.

The strategy "go up and take the nearest exit to the surface" might not be the best response. To support this assessment an understanding of the air flow driving the motion of smoke, its links with internal climatology and external weather conditions and the evacuation capabilities of subway tunnels, is needed. To support this exploration, 3D Computational Fluid Dynamic models have been developed, to validate field measurements and to gain an understanding of the internal airflow momentum and energy transfer capacity of subway stations in relation to external climatic factors and its effect on the dispersion of smoke and/or toxic agents.





2ND PRIZE

N. project: L1-81	**category: Rail**
Members: Fabrizio Cerreto	**University:** Technical University of Denmark
RA3	**Urban and Long-Distance People Mobility – Systems and Services**

Key Characteristics: Description of a method to reduce the high computational load typical of the micro-simulation of railway networks, with reasonable and quantifiable loss of information • Method to simulate problems that require large numbers of simulations in acceptable simulation time and reasonable accuracy • Simulation of a real suburban railway in Denmark •

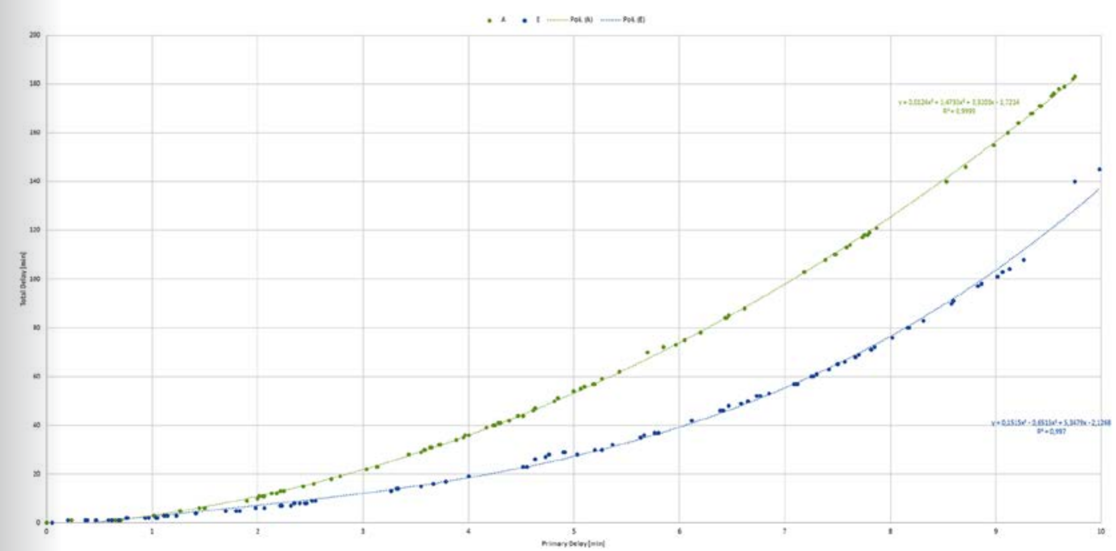
A Cubic Function Model for Railway Line Delay

Railway planners have a variety of methods and tools to simulate the operation. Simulation allows the evaluation of the railway system's quality, which includes infrastructure, rolling stock, and operational rules, as the timetable and the dispatching criteria.

This study describes a method to reduce the high computational load typical of the micro-simulation of railway networks, with reasonable and quantifiable loss of information. The simulation of railway systems can be performed at different levels of approximation, depending on the analyses type and on the problem size. In a macro-simulation model the infrastructure is usually represented as a graph where the nodes are the stations and the edges are the connections between them. On the opposite side, a micro-simulation model takes into account the actual tracks layout in open lines and within the stations; train movements are not considered in fixed running time but computed every instant through the rolling stock and line characteristics. A midway point is represented by mesoscopic simulation, more detailed in the infrastructure models, still regardless the signaling systems. Micro-simulation models are typically used in small problems and single line analyses, due to their intensive computation. Meso- and macroscopic models fit better for network simulation since they are faster, but loose in accuracy, which makes them unsuitable for single lines simulation.

We propose a method to simulate problems that require large numbers of simulations, as the comparisons of different scenarios or stochastic analyses, in acceptable simulation time and reasonable accuracy. A skimming method is used for the selection and simulation of a delayed train course that can represent the total train delay along the line. The reduction in simulation scenarios is calculated exactly, while a statistical approach is applied to estimate the accuracy lost.

Total delay measured on the line after primary delay to either line A or E



3RD PRIZE

N. project: L1-94 | **category:** Rail

Members: Giovanniluca De Vita, Davide Leonetti | **University:** Università Federico II Napoli

RA6 | **Transport Infrastructures**

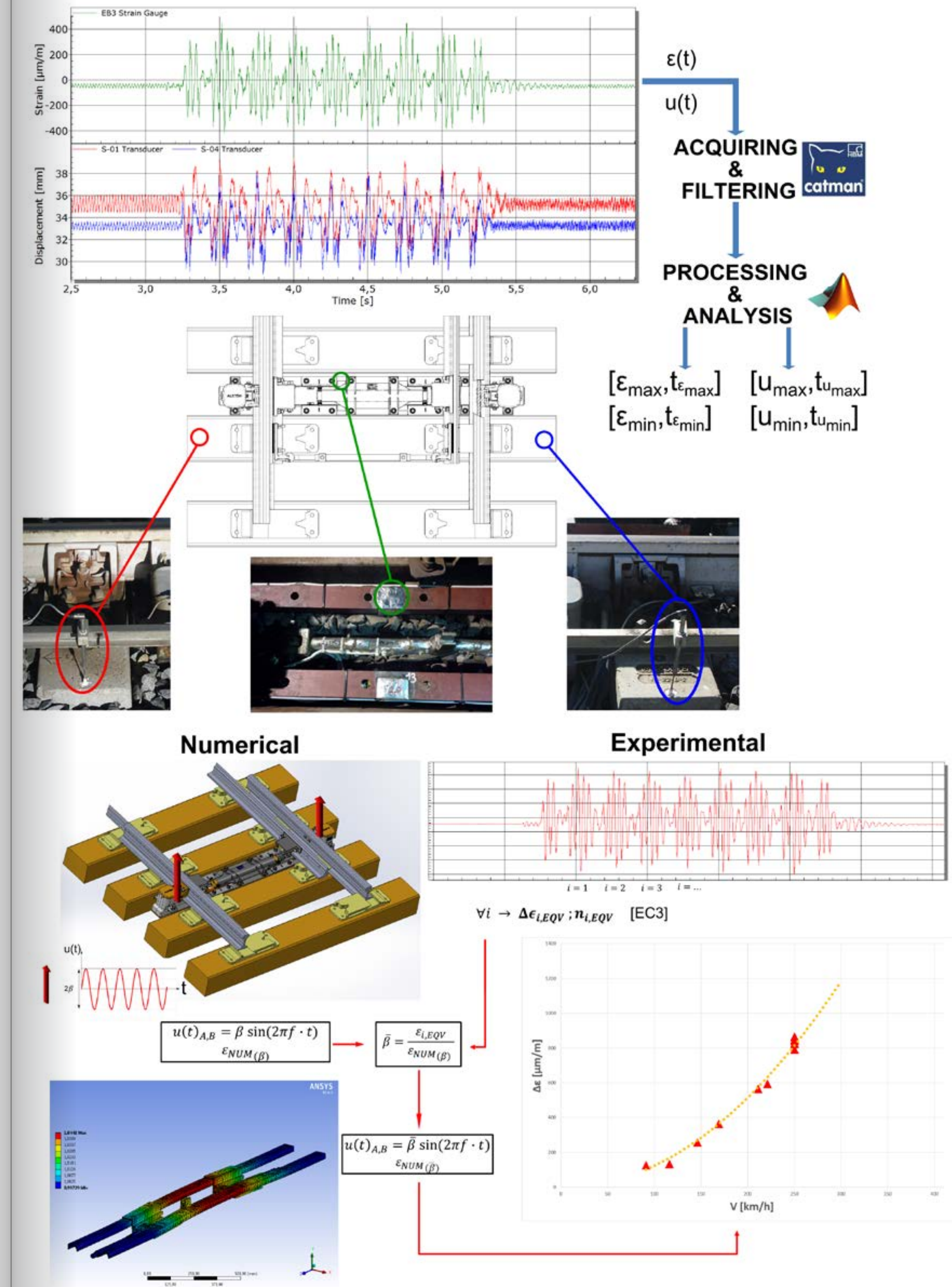
Key Characteristics: Testing of recently developed track equipment • Definition of a procedure to measure parameters such as displacements, accelerations and forces • Evaluation of variables which delineate the performance of track equipment •

A numerical and experimental approach for the diagnosis of high-speed railway turnouts

Nowadays an important concern in railway transportation is the shortening of travel duration and the possibility to reach as more places as possible.

The increasing speed of trains is a reply to the growing demand of passengers and freight transport to create a serious alternative to air and road traffic: the new Italian ETR1000 will reach a maximum speed of 400 km/h and a commercial speed of 360 km/h. Railway track is demanded to withstand higher lateral and vertical loads. For this reason, in the last years the railway equipment has been improved with both the UIC 60 rail profile and heavier ties, and new solutions for switches and turnout systems were carried out. Nevertheless switches and turnouts represent some of the most critical components due to the complex phenomena of rail-wheel contact, wear and vibrations. As the train speed increases, these phenomena become more severe, and maintenance plays a key role for modern railway networks. The aim of this study is to develop and validate a numerical model which allows to simulate and forecast the behavior of switches locking devices, at the moment certified for train speeds up to 300km/h, in order to define a step-by-step methodology to verify the structural requirements of the railroad equipment as a function of trains speed.

For the validation of the numerical model, the project is supported by experimental data of a case study related to a railway switch maneuvering system installed on the Italian high-speed railroad. In particular, the numerical model comprises all the structural parts of the locking devices, while the boundary condition are applied where the mechanism is bolted to the rails. By monitoring the vertical displacements of the rails, it is possible to assign, as function of the speed, the boundary conditions to the numerical model, and calculate both the stress and strain field.



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