Training in Reducing Uncertainty in Structural Safety

WORKSHOP
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Foreword

Inspections and maintenance of infrastructure are expensive. In some cases, overdue or insufficient maintenance/monitoring can lead to an unacceptable risk of collapse and to a tragic failure as the Morandi bridge in Genoa, Italy, on 14th August 2018. An accurate assessment of the safety of a structure is a difficult task due to uncertainties associated with the aging and response of the structure, with the operational and environmental loads, and with their interaction. During the period from 2015 to 2019, the project TRUSS (Training in Reducing Uncertainty in Structural Safety) ITN (Innovative Training Network), funded by the EU H2020 Marie Skłodowska-Curie Action (MSCA) programme, has worked towards improving the structural assessment of buildings, energy, marine and transport infrastructure. Fourteen Early Stage Researchers (ESRs) have been recruited to carry out related research on new materials, testing methods, improved and more efficient modelling methods and management strategies, and sensor and algorithm development for structural health monitoring purposes. This research has been enhanced by an advanced program of scientific and professional training delivered via a collaboration between 6 Universities, 1 research institute and 11 companies from 5 European countries. The high proportion of companies participating in TRUSS ITN has ensured significant industrial expertise and has introduced a diverse range of perspectives to the consortium on the activities necessary to do business in the structural safety sector. The training has consisted of a 'joint supervision' by industrial and academic experts, periodic monitoring and updating of a career development plan, 'network-wide training' where all ESRs have been brought together to be taught transferrable skills such as communication, entrepreneurship and management skills in addition to research topics, and 'local training' allowing the ESR to be exposed to different working and cultural environments. A key aspect of the local training are meaningful placements, with a main host where the ESR has carried out most of the research activity during three years, and secondment periods in other Universities and companies complementing the training at the main host. This mobility, which is a fundamental characteristic of the MSCA ITN scheme, has given ESRs an opportunity to access modules at the Universities, to have exposure to large enterprises and SMEs, to experience the international dimension of the project, and to gather practical knowledge in the application of skills acquired in the taught modules. Under this umbrella, all ESRs have had placements in both research-active industry and academic participants, have conducted work placing them at the forefront of their field, and have been directly exposed to the commercial world getting ready for a subsequent professional career.

This book is a compilation of the papers presented by the TRUSS team at their 2nd workshop. The workshop has been held within the 2018 Civil Engineering Research in Ireland (CERI) national forum through interaction with the Civil Engineering Research Association of Ireland. In the introductory paper, an overall view of the project is provided. Then, ESRs report on some of the their latest findings, starting by Sofia Antonopoulou (ESR1), who has reduced the uncertainty associated to the performance of Braided Fiber Reinforced Polymer (BFRP) through a comprehensive numerical and experimental campaign. Discrepancies between the true strength of reinforced concrete and the strength measured on site have been tackled via a novel testing method by Shah Nur Sourav (ESR2). Some limitations are computational, i.e., simulation time required for estimating fatigue life in large steel structures, when Rui Teixeira (ESR4) has proposed Kriging models to reduce the more expensive Monte Carlo simulations. There is also a relatively large degree of uncertainty between the dynamic response of numerical models and the true responses in complex scenarios such as submerged free-standing nuclear racks subjected to an earthquake that have been investigated by Alberto González (ESR3), or a ship unloader subjected to a moving trolley that has been analysed by Giulia Milana (ESR6). Distributed Optical Fiber Sensors (DOFS), sensors mounted in Unmanned Aerial Vehicles (UAV) and sensors in land vehicles have been further developed by Antonio Barrias (ESR11), Siyuan Chen (ESR14) and Daniel Martinez (ESR12) respectively, to efficiently gather on-site information about the structure. Algorithms able to convert on-site information into a realistic assessment of the structural condition have been proposed for bridge infrastructure by Farhad Huseynov (ESR7), Barbara Heitner (ESR8), Matteo Vagnoli (ESR9) and John James Moughty (ESR10). When managing infrastructure, questions arise on when and how to inspect it, that Guang Zou (ESR5) has addressed with advanced probabilistic methods taking the probability of detection of damage, the time taken until repair and the cost into account. Finally, Federico Perrotta (ESR13) has used field data to build a relationship between fuel consumption and road condition that allows integrating costs within the whole life cycle assessment of pavements. In summary, TRUSS proposes an advanced training and research programme at doctoral level that will qualify graduates for dealing with the challenges of an aging European infrastructure stock, thereby meeting a critical need whilst at the same time enhancing their career prospects in both industry and academia by matching their skills to the jobs of the future.

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