Editorial

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‘Self-monitoring and adjusting in real time’ (Smart) infrastructure holds promises to solve many of the problems we are currently facing. Maintaining Smart infrastructure may be improved by moving from scheduled maintenance schemes to predictive maintenance schemes. Therefore, Smart infrastructure has the potential to significantly reduce the financial burden imposed on public budgets by the continuous maintenance and upgrading requirements of our infrastructure systems. Smart infrastructure also holds the promise to automatically adjust to environmental changes, such as being able to react to short-term usage peaks or long-term changes in infrastructure user behaviour, allowing the design and planning of agile infrastructure systems that are more responsive to the ever-changing requirements of our modern societies. Finally, Smart infrastructure has enormous potential to increase the safety of our infrastructure by increasing possibilities to implement early warning systems and fail-safe mechanisms.

To design Smart infrastructure systems, three main challenges need to be resolved. First, sensors that can collect the required data about the real-time behaviour of the infrastructure system and its environment need to be designed and deployed. Second, advanced data fusion and analytical methods that can deal with the incoming big data from all the deployed sensor systems need to be developed. Third, decision-making methods that categorise and predict different conditions of the infrastructure system according to the fused and analysed data need to be implemented. Without a doubt, these three areas will be driving a lot of scientific research and entrepreneurial development in the years to come. Providing an outlet for these research and development results is one of the reasons for establishing the new journal of *Smart Infrastructure and Construction*.

This themed issue will focus on the second challenge – how to analyse and fuse big data. I see this topic as currently being the most pressing. The community has made significant advances in designing and deploying sensors and measuring many aspects of the behaviour of infrastructure systems and their environment in the last decades. Now we are collecting enormous amounts of data about more and more aspects of our infrastructure systems, structures are routinely equipped with advanced sensor systems, and we collect precise geometrical data using advanced light-detection and ranging systems. Additionally, data about infrastructure user behaviour are increasingly becoming available, collected, for example, by smart phone applications, camera systems or smart meter systems. At the same time, the exponential increase in the available computing power that has been witnessed in the last decades makes comprehensive analysis of these extreme large amounts of data possible for the first time.

Therefore, we hope and expect that we will be publishing many papers dealing with advanced data fusion and analytics issues around our infrastructure systems in the upcoming years. This themed issue intends to make an initial start in this direction.

One additional ambition of this issue was to start the exploration of the different characteristics of big data. Big data is often characterised not only as data that are high in volume, but also as data that are highly diverse in their type and nature (a characteristic commonly referred to as ‘variety’), are generated at a high rate (a characteristic commonly referred to as ‘velocity’) and come in different levels of quality (a characteristic commonly referred to as ‘veracity’). All of these characteristics make the analysis and fusion of big data very complex and sophisticated, again an issue that needs to be addressed by the research community in the years to come, if the move to Smart infrastructure systems is to be realised.

Answering our call for papers, we received several submissions for the special issue. After a highly competitive and rigorous peer review process, we finally decided to publish three papers. The first two papers in this themed issue focus on analysing data collected around bridges, one of the key assets of our major transportation systems. In the first of these two papers – ‘Real-time statistical modelling of data generated from self-sensing bridges’ – Din-Houn Lau *et al.* (2018) focus on developing data analysis methods that can deal with data that are generated at a high rate (i.e. the paper focuses on how to deal with the velocity of big data). Din-Houn Lau *et al.* show how such data can be used to detect train passages over the bridge and to predict strains.

In the second paper of this themed issue – ‘Using data to explore trends in bridge performance’ – Bennetts *et al.* (2018) focus on the variety and veracity of data, providing a study on how to use the vast amount of data available at Highways England to support bridge asset management. The paper explores how data from different sources available, such as bridge inventory data, bridge inspection records and data about historic and current defects, can be used to identify trends around the condition of the thousands of bridges managed by Highways England.

The final paper – ‘Recreating passenger mode choice-sets for transport simulation’ also focuses on how to deal with the variety and veracity of big data. Unlike the first two papers, Hillel *et al.* (2018) focus on identifying the mode-choice behaviour of passengers combining individual trip records from the London Travel Demand Survey with trip trajectories collected from Google Maps’ application programming interface. In doing so,

the paper additionally provides an interesting example of how to combine purposefully collected data with other data sources available in the open domain to support our decision making. With its focus on trips, the paper exemplifies how we can use big data to not only learn more about the behaviour of infrastructure assets, but also about the behaviour of the users of the infrastructure systems.

REFERENCES

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