applied sciences

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Editorial

SI 'Multiscale Fatigue Design'

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Received: 28 August 2019; Accepted: 3 September 2019; Published: 5 September 2019

1. Introduction and Scope

Prevention of unexpected failures is a fundamental design objective in any engineering structure or system subjected to fatigue. Nevertheless, the complexity of modern structures and the interactivity among engineering systems, coupled with human fallibility, means that failure and its consequences can only be avoided according to statistical probabilities. Hence, occasional catastrophic failures will occur with some of them involving the loss of human lives. Within the last few decades, a dramatic advancement has been achieved in many of the necessary technologies to either avoid or mitigate the consequences of failure. This advancement is associated with ever-increasing performance objectives for materials, structures, and machines, and the increased complexity of engineered products and processes. Alongside this, catastrophic failure and its consequences are considered less tolerable in society as a whole; this ensures that efforts to prevent unexpected failures are now a cornerstone in modern engineering design and, simultaneously, a technological and scientific challenge. There is an increasing acknowledgement in the engineering community that the response to this challenge, that is, prevention of catastrophic failure, generally requires a systems approach and necessitates engagement of a large pool of multidisciplinary expertise and the deployment of tools for systems analysis. This multidisciplinary pool includes materials science, structural analysis, manufacturing technologies, quality control and evaluation, mathematics, physics, and probability and reliability. Furthermore, from the scientific point of view, there is also an increasing acknowledgement that addressing the complex engineering problems of today requires the use of concepts and approaches that can account for size and time scaling effects.

The Special Issue embraces interdisciplinary work aimed at understanding and deploying physics of fatigue and failure techniques, advancing experimental and theoretical failure analysis, modeling of the structural response with respect to both local and global failures, and structural design that accounts for scale and time effects in preventing engineering failures.

2. Contributions

The topics touched by the Special Issue are very wide. Recent developments in high cycle fatigue in presence of defects, and fatigue in aggressive environments such as high temperature and corrosive media, are properly faced by different authors providing an update and advanced state of the art. *The importance of the scale effect and multiscaling nature of fracture and fatigue damage is well underlined in several contributions*. This is very evident in some of the papers published in the present Special Issue where the interactions between scales are very relevant and impacting on the final behavior [1,2]. Some relevant applications have also been discussed in the Special Issue [3–5].

3. Conclusions and Outlook

As Editor of this Special Issue, I would like to thank all the authors for their contributions. The priceless contribution of the reviewers is also highly appreciated; their constructive comments and suggestions significantly improved the quality of the published papers. Finally, a special thanks goes

to the Editorial Office for the opportunity they gave to the authors to disseminate their work through this Special Issue.

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