

Jury Report

Tata Steel Graduation Award for Mechanical Engineering and Materials Science 2021

A.M. (Asif) Hasan MSc, Delft University of Technology

Thermal Turbulence in Variable Property Channel Flows: DNS and RANS

Six MSc theses (awarded by four different Dutch Universities) were submitted this year for the TATA Steel Award for Mechanical Engineering and Materials Science. The jury is very pleased with the high level of the submitted theses, representing the field in its full width: from nanostructured functional devices to large scale industrial devices and even plant retrofits. Most of the nominated studies were of a conceptual or computational nature, while one of them presented experimental research. Interestingly almost all projects dealt directly or indirectly with energy efficiency.

The six theses reflect the impressive quality of the mechanical and materials science education and research at our Dutch universities. The selection of a winner was not a simple task due to the excellent quality of the nominated candidates. All nominees were of such a high quality that they all were in principle eligible for the award. However, after careful considerations and deliberations, the jury unanimously decided to award the 2021 Tata Steel Prize to Asif Hasan, a graduate (and now PhD student) of the Faculty of Mechanical, Maritime and Materials Engineering (3ME) of the TU Delft. The prize winner was supervised and nominated by Dr. René Pecnik and Dr. Sabrina van de Velde.

Asif Hasan received his BSc degree Mechanical Engineering from the University of Mumbai (India) on a project related to the design and manufacturing of a torque biasing differential for a racing car. Even then his qualities were already noted and he secured a prestigious All India First Rank classification. In 2019 he started the MSc program Energy and Process Technology at the TU Delft with some financial support from the J.N. Tata Endowment program. Asif started his research project in 2020 and graduated June 2021. His graduation work was graded a super high score of 9.5, while the overall score of all his MSc grades was only marginally lower at 9.3. As a result he graduated 'cum laude'.

The topic of his project was "Thermal Turbulence in Variable Property Channel Flows". While the complex topic of turbulence has been studied extensively for ideal fluids like air and water, turbulence, and in particular turbulent heat transfer in non-ideal fluids (like super critical fluids, molten salts, liquid metals) is as yet relatively unexplored due to the enormous physical and computations challenges.

Hasif's extraordinary analytical skills allowed him to unveil (and explain 😊) complex energy transfer mechanisms that were unknown prior to his research. The work, performed on the largest supercomputer in the Netherlands, led to a new model that allows the quantitative prediction of turbulent heat transfer in non-ideal fluids, both for low-Mach number flows and high-Mach number flows even in the case of non-uniform viscous heating. To this aim he included an enthalpy variance equation in the source term of his model. Conventional turbulence models, notwithstanding that they have been worked upon for decades, fail drastically in making accurate predictions under these conditions. A journal paper regarding his MSc graduation project is in preparation, or may even have been submitted.

In conclusion, while his fellow nominees also showed exceptional talent and achievements, the jury was unanimously of the opinion that Asif Hasan should be the winner of the Tata Steel Graduation Award for Mechanical Engineering and Material Science 2021.

Prof. dr. ir. J. (Han) Huétink, em. Professor of Mechanical Engineering University of Twente

Prof. dr. ir. S. (Sybrand) van der Zwaag, em. Professor of Materials Science and Aerospace Engineering Delft University of Technology

The jury meeting took place October 13th, 2021 at the offices of the Koninklijke Hollandsche Maatschappij der Wetenschappen in Haarlem. The meeting was chaired by Mr. drs. T.S.M. (Thérèse) van Schie, one of the directors of the KHMW, and was also attended by Prof. dr. A.P. (Ad) IJzerman, Secretary of Natural Sciences KHMW and Drs. S. (Saskia) van Manen, Secretary KHMW (minutes).