

Thomas Ochabski wins best student presentation prize at AeSSA 2019 Annual Conference

Stellenbosch University Master's student Thomas Ochabski walked off with the laurels for his presentation titled *A Large Design Space Multidisciplinary Optimisation of a Mixed Flow Micro Gas Turbine Compressor Stage*, on 17 October 2018 on day 2 of the AeSSA 2019 Annual Conference. His presentation was evaluated as follows by Session Chair Kevin Jamison: "Thomas had a very well-structured and engaging presentation that also showed real technical merit, presenting a viable approach to the very difficult challenge of optimising the compressor of a mix flow jet engine."

Ochabski's primary supervisor is Prof Johan van der Spuy. Dr Thomas Hildebrandt is a co-supervisor, who enabled Ochabski to spend five months at NUMECA Ingenieurbüro in Germany to further his research. Ochabski says, "During my time abroad I developed my skills with the team of engineers and held meetings for feedback on my progress. I used an in-house Python script coded by the team, which was used for computational fluid dynamics (CFD) optimisation and gave feedback on my use of the code to help them in its development." He notes that German was the office language; this, he comments, drastically improved his proficiency in German during this time.

The initial scope of Ochabski's research project – investigation of the optimal mixed flow angle of a mixed flow impeller – was proposed by Prof van der Spuy. Ochabski notes, "During my time in Germany, the scope increased significantly due to the rapid progress under the guidance of the highly skilled team and plenty of long (snowed-in) days in the office." Many of the scope expansions, such as performing a multi-row and multidisciplinary optimisation, were suggested by the German team. He points out that the CSIR gave design requirements to aim for during the optimisation. "Ideas of using a highly coupled parametric model to explore significant geometry variations and statistical analysis of parameter-response correlations were of my own thinking," he confirms.

He took approximately two years to complete this research project, which included a semester of post-graduate modules aligned with his work to deepen his understanding of the field, and 17 months spent on research. The title of his dissertation is *A Large Design Space Multidisciplinary Optimisation of a Mixed Flow Micro Gas Turbine Compressor Stage*.

Ochabski explains his hypothesis as the existence of an optimal mixed flow angle of less than 90 degrees for a compact micro gas turbine compressor stage. He confirms, "The optimised design features a 71-degree mixed flow angle, which proves my hypothesis. In the process of proving the hypothesis, key findings were made, which describe the influence of diffuser outlet height and wrap angle to stage performance. This had not previously been done for a continuous vane diffuser. An optimisation with very large variations in geometry had also not previously been performed for such a compressor stage." The design theory attained is applicable to all continuous vane diffuser compressors and thus could assist future turbomachinery designers.

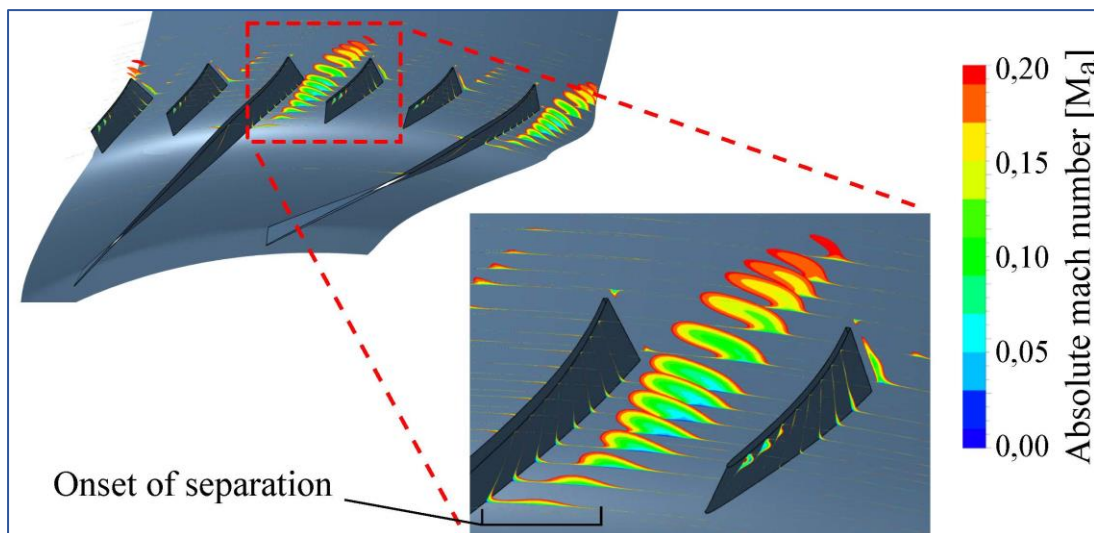
Ochabski says he is investigating turbomachinery or aerospace-related work in South Africa: “Ideally I would like to work in any form of CFD or finite element analysis research and development environment as this is what I'm most passionate about.”

He says his goal at the AeSSA conference was to discuss with the CSIR the possibility of experimental testing of the stage and to discuss the possibility of application to their engine for which they originally supplied the design requirements. He notes, “Testing is not yet possible since their new high-power test bench is not yet developed (compressor requires 205 kW). The engine project was discontinued.”

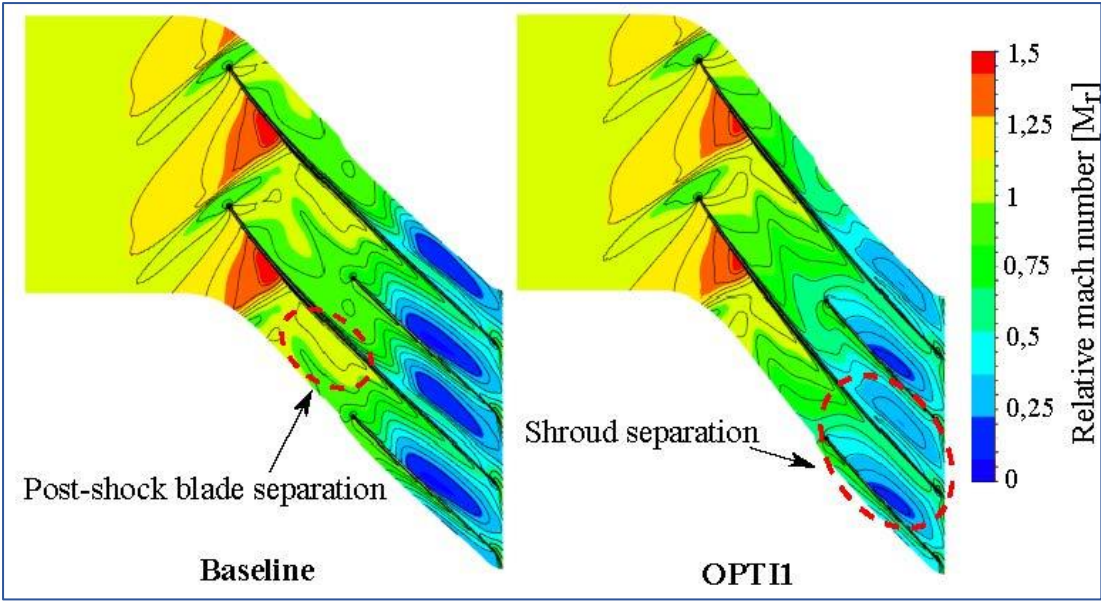
However, attending the AeSSA Conference helped him make “multiple connections with people from the industry for the purpose of exchanging knowledge and organising possible future work possibilities.” He is open to a further stint overseas to grow his expertise. In the meantime, he is completing his publication for the 2020 ASME TurboExpo Conference in London.

As an outdoor enthusiast, Ochabski enjoys mountain biking and hiking in South Africa. The AeSSA wishes him well for the future.

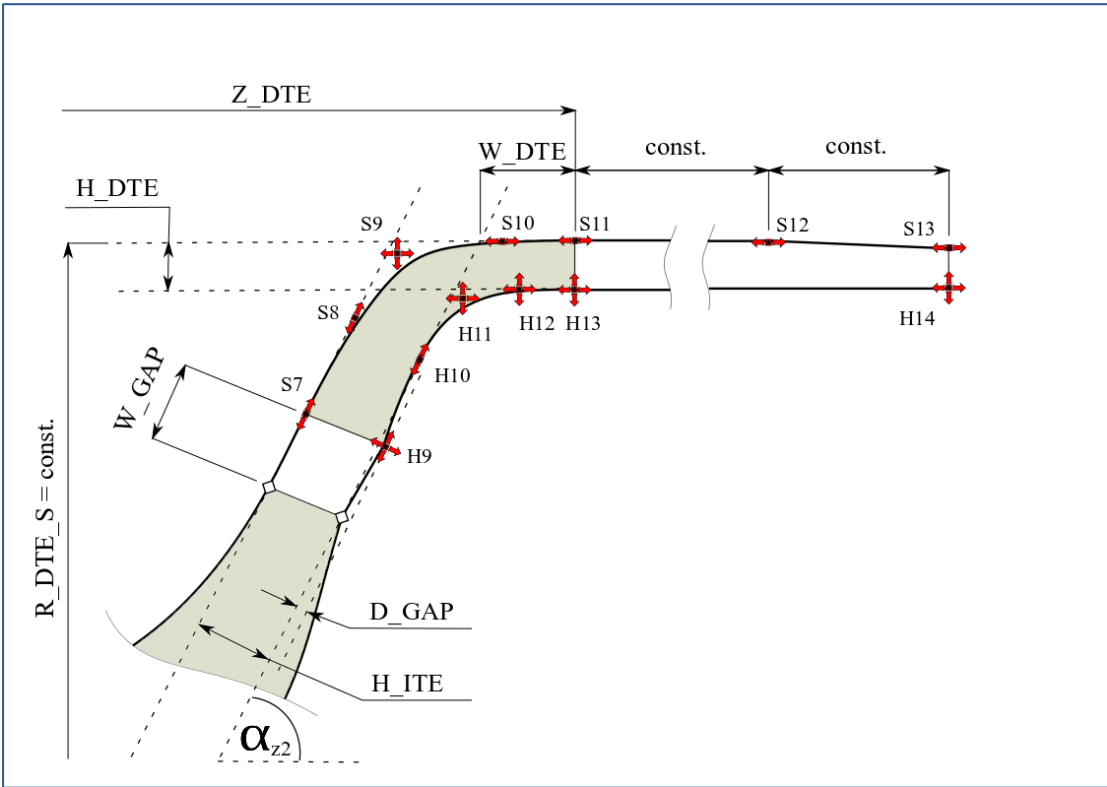
The following images were supplied by Ochabski.



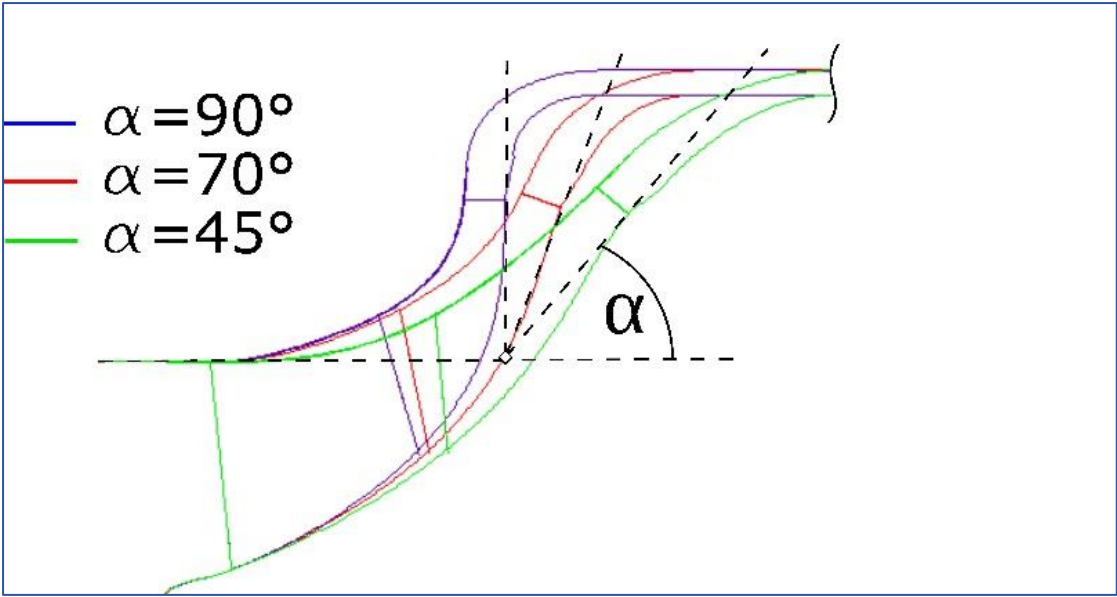
Diffuser flow separation



Impeller near shroud flow improvement



Diffuser parametric model



Sample designs



Final design