

TRACK 3: PROPULSION
“A ONE-DIMENSIONAL (1D) STAGE UN-STACKING APPROACH TO REVEAL FLOW ANGLES AND SPEEDS IN A MULTISTAGE AXIAL COMPRESSOR AT THE DESIGN OPERATING POINT”

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ABSTRACT

Stage stacking methods commonly use a 1D through flow analysis at the mean line to design an axial compressor from individual stages and stack these to form a multistage axial compressor. This stage of design exerts a great influence on each stage's pressure and temperature ratio. The design process for an individual stage is usually guided by design values and rules known from previous designs. This study develops a 1D stage un-stacking method that uses a minimal set of data from an actual axial compressor, while reducing the needed number of assumptions. Proceeding from the premise that an actual axial compressor design fulfils all thermodynamic requirements, velocity triangle requirements and design guidelines simultaneously, this proposed stage un-stacking method calculates the pressure, temperature, velocities and flow angles as a set of dependent data at each stage of the axial compressor. The dependent data with realistic blade angles eliminates guessing the blade angles when constructing the geometrical model of an individual stage. Using the blade angles from stage un-stacking the axial compressor of a common power aero-derivative gas turbine, a greatly simplified 3D 1/72 geometrical model was constructed and tested with a computational fluid dynamics simulation.

BIOGRAPHY OF SPEAKER


Mr Alan is currently a PhD candidate at the School of Mechanical and Aerospace Engineering, Nanyang Technological University. He obtained a Masters in Mechanical Engineering from Faculty of Engineering, National University of Singapore in 2013. Alan has more than 8 years' experience in mechanical engineering. He was a field engineer leading the ground support for helicopter operations in search and rescue flights for 4 years. In his Masters of Engineering, he carried out experimental work in a wind tunnel examining ground effect for a finite width NACA 4415 airfoil. He has also gained extensive experience refurbishing the wind tunnel test section. Alan is currently responsible for investigating the effect of ingested flammable gas on ignition risk for a gas turbine through his PhD to support consultancy in at Lloyd's Register Global Technology Centre.