



# ME PhD Thesis Defense



## Thermal Turbomachinery Design for Closed Thermal Cycles and Multiple Fluids

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### ABSTRACT

This research work provides an understanding of the true essence of closed-cycle gas turbines with the focus on development of turbomachinery design methodologies. The survey of over 100 concept design cycles for closed-cycle gas turbines has helped in summarizing the turbomachinery design uniquely on two charts, one in absolute (enthalpy-mass flow rate-diameter) scale and the other in non-dimensional (specific speed-specific diameter) scale which clearly provides a path for any new turbine shape to be designed for any application. The critical turbomachinery design methodology comprises of two schools of thought. The first one involves scaling a benchmark design for different fluids catering to a particular application. The second one is a thorough step-by-step meanline design methodology for both turbines and compressors for any new application. Both these strategies have been employed in this work for the development of turbomachinery for thermal power cycles such as supercritical carbon dioxide Brayton cycle, Organic Rankine Cycle and steam Rankine cycle, as well as non power-generation thermal cycles such as air cycle and cryogenic liquefaction cycle. The success of both these methodologies is endearing, and in some cases one is better than the other. The beauty of scaling strategy from benchmark models is that it can provide a much better solution when a new turbine design is constrained by uncertainties of performance. The success of scaling strategy presented here can inspire turbomachinery designers to use the power of similitude for the design of turbomachinery before employing detailed meanline design methodologies for starting the design from scratch.

### ABOUT THE SPEAKER

Mr. Vijayaraj Kunniyoor is a PhD scholar in the department of Mechanical engineering at IISc Bangalore, working with Prof. Pradip Dutta and Dr.-Ing. (Habil) Punit Singh in the field of Turbomachinery. He graduated in Mechanical Engineering from College of Engineering, Trivandrum. He did his post-graduation in Thermal Engineering from the Indian Institute of Technology Madras, India. His research focuses on the design of thermal turbomachinery.



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