

Heat Pump Dynamics

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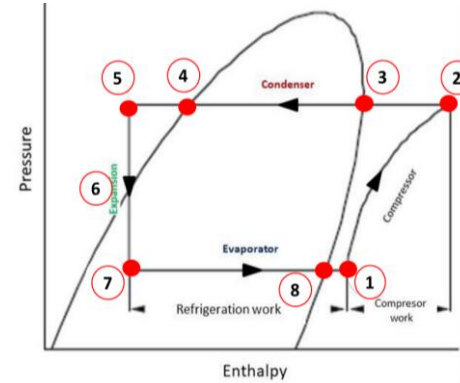
¹: Thermochemical Power Group, University of Genoa, Genova, Italy



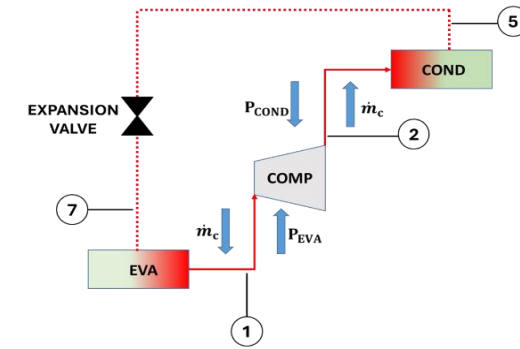
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Compression System Modelling Innovative for Heat Pumps

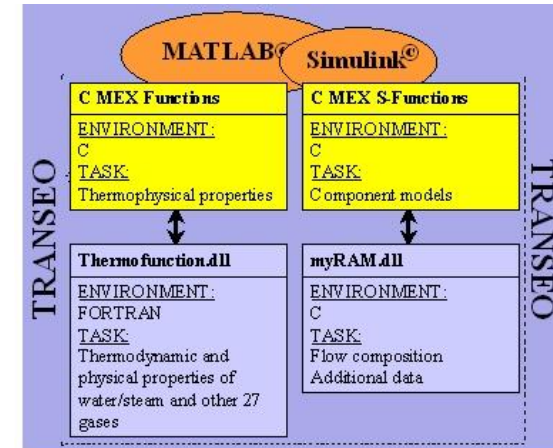
- Heat pumps that use dynamic compressors are closed loop, multi-phase systems with real gas effects, which are affected by surge & stall instabilities.
- These instabilities are different from those in conventional compression systems since the compressor is between 2 plena and the presence of phase change of the working fluid.
- At Thermochemical Power Group of University of Genova, Italy, these kinds of system are modelled using the in-house simulation tool of, called 'TRANSEO'.



Heat Pump Cycle



Schematic of the compression system

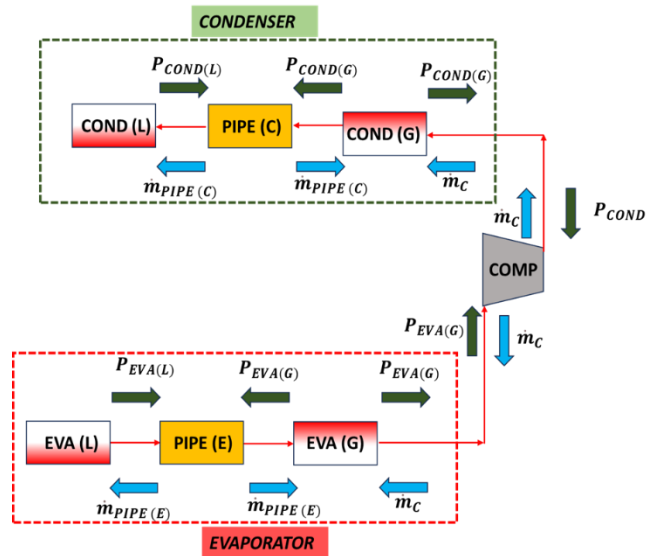


TRANSEO organization

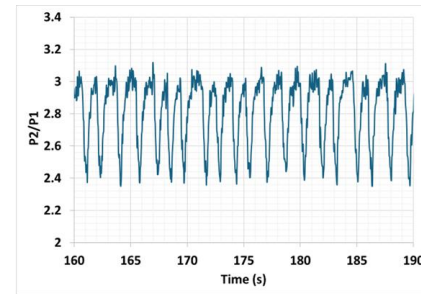
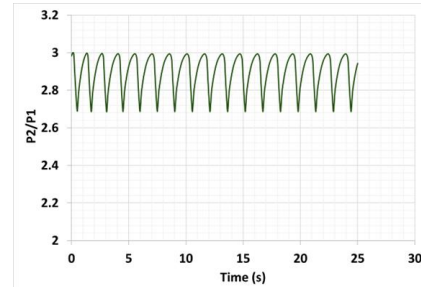
Traverso, A., "TRANSEO: A New Simulation Tool for Transient Analysis of Innovative Energy Systems: PhD Thesis," University of Genova, Genova, Italy, 2004.

Purushothaman, S., Reggio, F., Traverso, A., Niccolini Marmont Du Haut Champ, C. A., Silvestri, P., and Halbe, C. (August 27, 2024). "Centrifugal Compressor Surge in Closed Loop Systems: Initial Modelling and Comparison with Experiments." ASME. J. Eng. Gas Turbines Power. doi: <https://doi.org/10.1115/1.4066376>

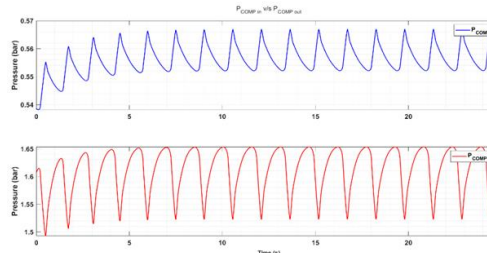
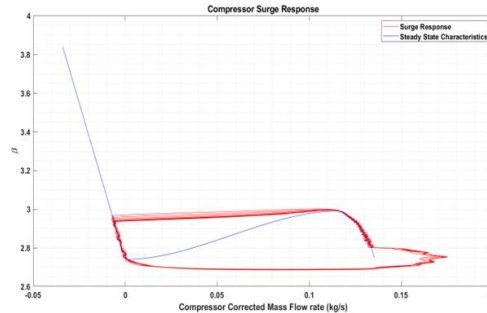
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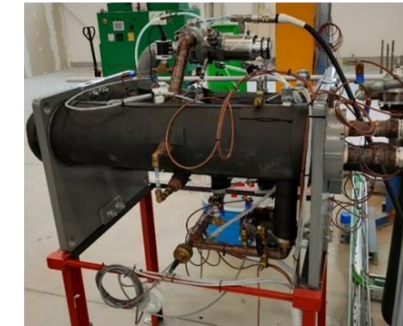
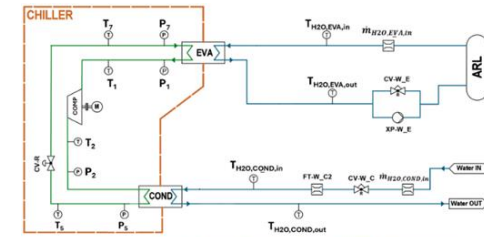
TRANSEO architecture of Heat Pump System



Compressor pressure ratio fluctuations
Model (top) & Experiment (bottom)



Surge response (model)



Experiment setup
P&I diagram (top) & test rig (bottom)

- Initial modelling has been done to capture low frequency post-stall transients and validated with experiments.
- Empirical data has been used to represent the heat exchangers (liquid part).
- Detailed dynamics are under investigation, with heat exchanger liquid level information from experiments.

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S. Purushothaman*, F. Reggio, A. Traverso, "Dynamic Modelling of a Closed-loop, 2 Phase Compression System for Heat Pump Applications", poster presented at 79th annual ATI Congress, 4-6 September 2024, Genova, Italy.



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