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Multiscale simulation of time-dependent thermal transpiration in large-scale systems[1] DUNCAN A. LOCKERBY, ALEXANDER PATRONIS, University of Warwick, MATTHEW K. BORG, University of Strathclyde, JASON M. REESE, University of Edinburgh — We describe the development of an efficient hybrid continuum-molecular approach for simulating non-isothermal, low-speed, internal rarefied gas flows, both in time and space. This is applied to transient flow in macro-scale Knudsen compressors, which is governed by both rarefied gas and continuum fluid dynamics. The method is an extension of the hybrid approach presented by Patronis et al. (2013) [J. Comp. Phys., 255, pp 558-571], which is based on the framework originally proposed by Borg et al. (2013) [J. Comp. Phys., 233, pp 400-413] for the simulation of micro/nano flows of high-aspect-ratio. The efficiency of the multiscale method allows the investigation of alternative Knudsen-compressor configurations to be undertaken. A comparison is made with published experimental data of the transient response (of pressure) in differentially heated reservoirs suddenly connected by a micro capillary. The multiscale simulation results compare very closely to the experimental data and are obtained at a fraction of the cost of a full kinetic or molecular solution. Recommendations for future development and opportunities are discussed.

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