Development of a 2D/3D Computational Fluid Dynamic Code for Analyzing Regenerators

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Regenerators are critical components of pulse tube and Stirling cryocoolers. The design of such cryocoolers is often centered around a careful and accurate design and analysis of their regenerator(s). Industry standard design tools such as SAGE and REGEN are efficient, however, they are 1D and cannot capture pore-level multi-D flow and heat transfer effects. Computational fluid dynamic (CFD) analysis of regenerators with commercial software such as ANSYS Fluent or COMSOL, furthermore, is a very time consuming due to the occurrence of periodic flow . A fast-running, flexible and efficient 2D/3D computational fluid dynamic (CFD) code is under development at Georgia Tech, specifically for the analysis of regenerators. Pore-level simulations can be carried out with this code for arbitrary and complex regenerator fillers. The computations are minimized by focusing only on critically important parameters. The theoretical and computational characteristics of this code are discussed, and typical code predictions representing friction, heat transfer and entropy generation, are presented and compared with experimental data as well as the predictions of the ANSYS Fluent CFD code.