Public Abstract
First Name:Earl
Middle Name:Lynn
Last Name:Tipton
Adviser's First Name:Sudarshan
Adviser's Last Name:Loyalka
Co-Adviser's First Name:Robert
Co-Adviser's Last Name:Tompson
Graduation Term:SS 2008
Department:Nuclear Engineering
Degree:PhD
Title:Chapman-Enskog Solutions to Arbitrary Order in Sonine Polynomials

The Chapman-Enskog solutions of the Boltzmann equations provide a basis for the computation of important transport coefficients for simple gases and gas mixtures. These coefficients include the viscosity, the thermal conductivity, and also, for gas mixtures, the diffusion and the thermal diffusion coefficients. In the standard method for computing the transport coefficients, the Chapman-Enskog solutions are expressed as expansions in Sonine polynomials because of the rapid convergence of this series for the transport coefficients. Due to the complex nature of the expansions, direct, general expressions have been limited to low-order solutions. In this work, the Chapman-Enskog solutions have been been explored to arbitrary, relatively high orders of the Sonine polynomial expansions. Explicit, symbolic expressions containing the full dependence of the problem on the molecular masses, the molecular sizes, the mole fractions, and the intermolecular potential model via the omega integrals have been generated and archived for orders of expansion of 150 for simple gases, of 60 for the viscosity-related solutions for a binary gas mixture, and of 70 for the diffusion- and thermal conductivity-related solutions for a binary gas mixture. Numerical results using high-precision arithmetic are reported for the above orders of expansion using the rigid-sphere potential model, as analytical expressions are available for the omega-integrals. These benchmark results are then compared with the rigid-sphere results of other authors reported in the literature and a good agreement between the results is demonstrated.