Characterizing gas film conduction for particle-particle and particle-wall collisions

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ABSTRACT

Granular heat transfer is an important mechanism in many industrial applications. For some applications conduction is the dominant mode of heat transfer. There are many proposed models to describe particle scale conduction both between particles (particle-particle) and also walls (particle-wall). Within these conduction models are several distinct modes: conduction through physical contact [1], conduction through surface roughness [2], and conduction through the stagnant gas film surrounding each particle often called particle-fluid-particle or particle-fluid-wall [3]. While these models have been well developed and validated in literature [4,5], the relationship between the conduction heat transfer coefficient and key parameters is not always clear. This is especially true for gas film conduction. In this work we investigate gas film conduction for particle-particle and particle-wall collisions via DEM simulations using a well-established gas film model [3,6] to determine the behaviour of the heat transfer coefficient as a function of the separation distance, particle size or size ratio. With a better understanding of the gas film heat transfer coefficient we propose a simplified model that captures the same response but is easier to understand and more computationally efficient. Beyond computational efficiency a simpler expression for the gas film coefficient is advantageous for developing scaling laws and the application of the gas film model for multi-sphered particles.

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