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Discrete element simulation of radial heat transfer in powder bed of 3D printing

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In powder bed based Additive Manufacturing (also 3D printing) processes like Selective Laser Melting (SLM) or Electron Beam Melting (EBM), the heat transfer mechanism between particles is very complicate. Due to the huge number of particles and small proportion of contact area, the calculation of radiation heat transfer between particles is very difficult, even using a continuous model by FEM (finite element method). A thermal radiation calculation method based on discrete element method (DEM) was proposed. The method include two steps, particle surface discretization and thermal integral accumulation to simulate radiation heat transfer process. The accuracy of the DEM-based thermal radiation calculation method was verified by comparing the results of the particle wall DEM model and the long plate theoretical model. The results indicate that under the same conditions, when the ratio (i) of particle wall length to particle size is greater than 100 and less than 500, the radiation heat transfer value of particle wall is larger than that of long flat plate. If the ratio (i) is greater than 500, the radiation heat transfer value of particle wall is closing to the theoretical radiation heat transfer value of long flat plate. With the increasing of ratio i , the radiation heat transfer value of particle wall is gradually equal to the theoretical radiation heat transfer results. The proposed method possesses the characteristics of high computational efficiency, can calculate the radial heat transfer with any shape surface and the calculation results are very accuracy.

Biography

Yuanqiang Tan has completed his PhD from Central South University of China. He is a Professor at the Institute of Manufacturing Engineering, Huaqiao University, a premier research organization of China. He has published more than 50 papers in reputed journals and has been serving as a Reviewer of reputed journals. His research interest is simulation of 3D printing.

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