Creating a Hybrid Agent/Grid Model of Contact-Induced Force

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Most computational fluid dynamics (CFD) models follow either a Lagrangian or Eulerian approach to study the performance of objects in fluid flow. These wind tunnel models monitor a multitude of response variables, one of the most important being lift. However, it is difficult to find models that instead use the collisions between individual air particles and the object of choice to report such variables. The goal of this research project was to build a hybrid agent/grid model in NetLogo that would use a coupled Eulerian and Lagrangian approach to measure contact-induced lift. In this model, the individual particles were represented by mobile agents, and the object of interest (in this case, a Clark Y wing) was represented by grid agents, as was the empty environment and the edges of the wind tunnel. The model included many control features, two of which were the magnitude of initial flow rate and the angle of attack of the wing. Experimental runs measured the lift force as a function of both these control features, and the results indicate that this type of agent/grid based approach to CFD is in fact viable.

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