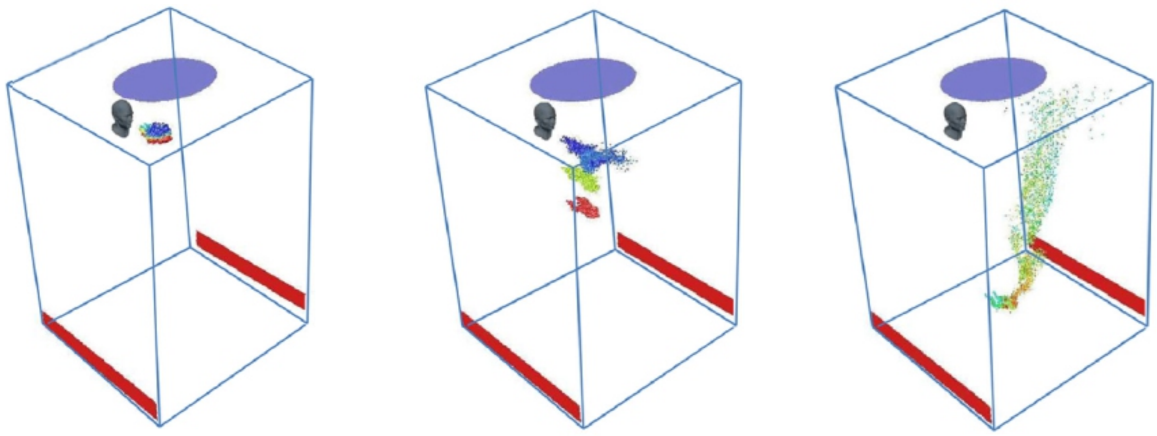
Eulerian–Lagrangian CFD Modeling

10

Transmission, Evaporation of Cough Droplets Inside an Elevator



Snapshots of the cloud of droplets generated due to coughing action by a person inside an elevator at different instants of time from the start of the coughing action. The color scale is for droplet diameter (dark blue represents the smallest droplets and dark red represents the largest droplets).

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A CFD model is developed to simulate transmission and evaporation of droplets generated due to coughing action. The model is used to understand spread of cough droplets inside an elevator for different scenarios.

Several practices were followed for social distancing during COVID-19 pandemic. These included practices on using elevators also such as only one person should use the elevator at a time, the persons using elevator should stand facing the walls of the elevator etc. To have a more scientific basis of such practices, fundamental studies on how the droplets generated due to coughing or sneezing action move and evaporate in different settings are needed. A pertinent question is what happens if someone coughs inside an elevator. An attempt was made to answer this question by carrying out numerical simulations. For this, a 3D Eulerian-Lagrangian CFD model was developed and used to understand the transmission and evaporation of micron-size droplet generated due to coughing action. Effect of turbulence created by the air puff associated with coughing action was considered. Effect of humidity on evaporation of droplets was also considered. Different possible scenarios varying in presence/absence of fan inside the elevator, number of persons coughing, direction of ejection of cough droplets, ambient relative humidity and temperature were postulated and simulated.

The results obtained showed that in presence of proper ventilation inside the elevator (in the form of a top-mounted fan), most of the ejected cough droplets fall to the ground before impacting other persons standing in the elevator. However, in absence of the fan, droplets sweep through a large volume inside the elevator after getting entrapped in the flow induced by the air puff exhaled during coughing action. An increase in temperature and a reduction in relative humidity increase the fraction of droplets getting evaporated. This work (Sen, Transmission and evaporation of cough droplets in an elevator: Numerical simulations of some possible scenarios, Physics of Fluids 2021, 33, 033311) was chosen as the Editor's pick.