Towards aerodynamically equivalent COVID19 1.5 m social distancing for walking and running

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Abstract

Within a time span of only a few months, the COVID-19 virus has managed to spread to many countries in the world. Previous research has shown that the spread of this type of viruses can occur effectively by means of saliva, often in the form of micro-droplets. When a person sneezes, coughs or even exhales, he or she is emitting small droplets – often too small to see with the naked eye – that can carry the virus. The receiving persons can be infected by inhaling these droplets, or by getting these droplets on their hands and then touching their face. That is why during the COVID-19 crisis, countries world-wide have declared – sometimes by law – a "social distance" of about 1.5 m to be kept between individuals. This is considered important and effective because it is expected that most of the droplets indeed fall down and reach the floor and/or evaporate before having traveled a distance of 1.5 m. However, this social distance has been defined for persons that are standing still. It does not take into account the potential aerodynamic effects introduced by person movement, such as walking fast, running and cycling. This aerodynamics study investigates whether a first person moving nearby a second person at 1.5 m distance or beyond could cause droplet transfer to this second person. CFD simulations, previously validated and calibrated with wind tunnel measurements of droplet movement and evaporation and of airflow around a runner, are performed of the movement of droplets emitted by an exhaling walking or running person nearby another walking or running person. External wind is considered absent and different person configurations are analyzed, side by side, inline and staggered, and the exposure of the second person to the droplets emitted by the first person is assessed. The results indicate that the largest exposure of the trailing person to droplets of the leading person for walking and running is obtained when this trailing person is in line behind the leading person, i.e. positioned in the slipstream. The exposure increases as the distance between leading and trailing person decreases. This suggests that avoiding substantial droplet exposure in the conditions of this study and in a way equivalent to the 1.5 m for people standing still can be achieved by one of two actions: either by avoiding to walk or run in the slipstream of the leading person and keeping the 1.5 m distance in staggered or side by side arrangement, or by keeping larger social distances, where the distances increase with the walking or running speed.

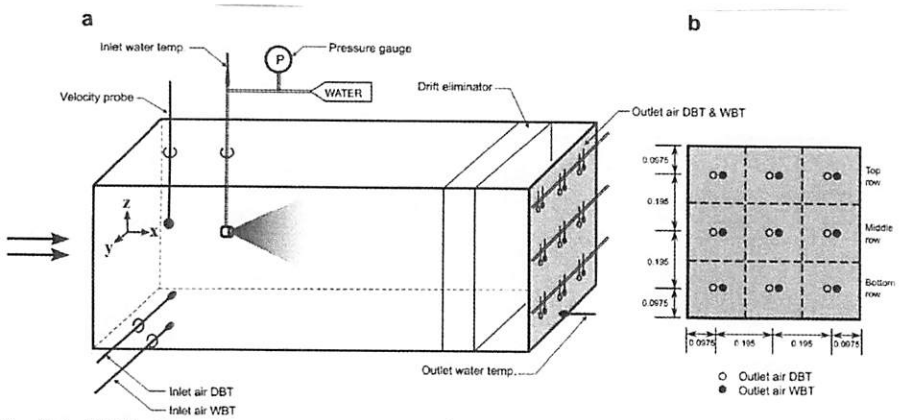

Fig. 1 (a, b) Wind-tunnel measurement setup with measurement positions in the outlet plane (modified from Sureshkumar et al. 2008). Dimensions in meter.

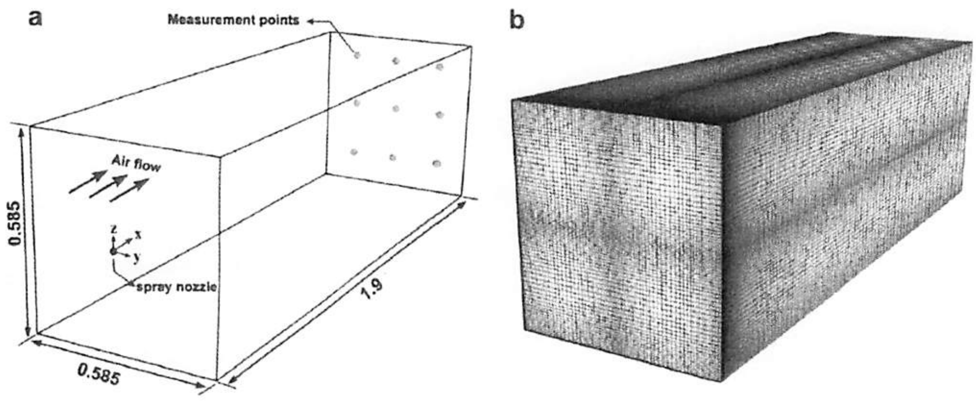

Fig. 2 (a) Computational domain (dimensions in meter). (b) Computational grid (1,018,725 cells).