Bulletin of the American Physical Society

71st Annual Meeting of the APS Division of Fluid Dynamics
Volume 63, Number 13
Sunday–Tuesday, November 18–20, 2018; Atlanta, Georgia

Session D32: Applied CFD II
2:30 PM–4:40 PM, Sunday, November 18, 2018
Georgia World Congress Center Room: B404

Chair: Catherine Gorle, Stanford University

Abstract ID: BAPS.2018.DFD.D32.3

Abstract: D32.00003 : Converting visually realistic L-System tree models into a porous media model for urban CFD
2:56 PM–3:09 PM

← Abstract →

Presenter:
Daniel Joseph Wise
(IHPC)

Authors:
Daniel Joseph Wise
(IHPC)

Woei Leong Chan
(Temasek Labs, NUS)

Chi Wan Lim
(IHPC)

Like Gobeawan
(IHPC)

Yongdong Cui
(Temasek Labs, NUS)

Hee Joo Poh
(IHPC)

As part of the Virtual Singapore (VS) initiative, steps are being taken to populate Singapore's digital twin with visually accurate tree models. The most detailed of these are created using Lindenmayer or L-Systems which accurately capture biological features such as branching angles, trunk/branch growth rates, and leaf fall rates. As Singapore is home to over 2 million trees, many of which are located in urban areas, it is imperative that they are modelled with sufficient accuracy when CFD analyses are performed.

Within the present work we outline the first steps in the development of a species-specific porous media model for CFD which takes the graphical models and converts them into a simulation-ready form. Wind-tunnel experiments are performed of the flow past biologically realistic, 3D printed trees of different species. Planar PIV measurements are used to evince the change in wake dynamics for each species, and it is shown that the trees impact the wind flow differently depending on their alignment with the oncoming flow. A method is proposed to introduce source/sink terms into the momentum, kinetic energy, and dissipation equations to mimic the presence of trees, where the magnitude of these terms is related to parameters computed from the L-System models.