

LES Study of Pulsating Impinging Jets for Heating and Cooling Applications

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ABSTRACT.

Large Eddy Simulation LES is used to study the dynamics and thermal field of heating and cooling, steady and pulsating impinging jets. The jets were forced by imposing pulsations at a frequency equal to 600 Hz. The study shows the behavior of two dynamically-identical jets when they are used for heating and cooling purposes, respectively. The focus is on the interaction of the primary vortices with the boundary layer developing along a convex target wall and the resulting effects on the thermal field. Different instantaneous parameters superimposed at different characteristic instants are used to elucidate the abovementioned interactions.

It is found that the trajectories of the primary vortices are repeatable up to a certain position, in the streamwise direction, then become erratic affecting the characteristic frequencies of their passage at different points.

The study shows that heat transfer deteriorates under the effect of forcing at the impingement region and beyond four jet widths from the impingement point. In addition, the jet for cooling applications performs better than that for heating applications beyond four jet widths from the impingement point. Indeed, the temperature of the surrounding air might have an important effect depending on the purpose of the jet application.

The dynamical and the thermal fields can be de-correlated intermittently which suggests that studies focusing on a single parameter do not provide sufficient information about the possible heat transfer improvement or deterioration under the effects of impinging jets.