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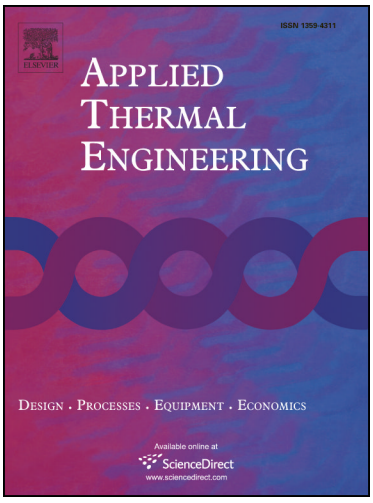

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Inverse optimization design of an impinging co-axial jet in order to achieve heat flux uniformity over the target object

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Abstract

In this study, co-axial impinging jet was optimized in order to obtain uniform heat flux over an isothermal heated surface by determining four design variables including geometrical and flow variables. The governing equations were solved using the finite volume method for a laminar, incompressible, and axisymmetric flow. The solution of inverse design problem was achieved by minimizing the root mean square of the difference between the local Nusselt number and the uniform design Nusselt number. A combination of pattern search and gradient-based methods was used for optimization. Also a co-axial jet with a new geometry was presented to improve the objective function and two design variables were added to the four previous variables. Optimization was performed for two jet configurations under 15 different conditions. Heat flux uniformity was obtained by these two jets with acceptable errors less than 2% for the outer jet to the target surface diameter ratios of higher than 0.6. The proposed co-axial jet showed its superiority at the small diameter ratios (0.4 and 0.3) and it reduced the error significantly (about 50%) for design Nusselt numbers of 7 and 10.

Keywords: Impinging jet; co-axial jet; inverse design; optimization; heat flux uniformity; pattern search method

Nomenclature

g	gravity acceleration
h	heat transfer coefficient on the target surface
k	fluid conductivity
t	target surface thickness
v	velocity

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