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CONJUGATED HEAT TRANSFER IN MICROCHANNELS WITH SLIP FLOW REGIME VIA SINGLE DOMAIN FORMULATION AND INTEGRAL TRANSFORMS

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ABSTRACT A methodology has been recently proposed and advanced for the analysis of conjugated conduction-convection problems, through a combination of a single domain formulation strategy and integral transforms, by merging the energy equations for the solid and fluid regions into a single problem, for the whole spatial domain. Making use of space variable coefficients with abrupt transitions occurring at the fluid-wall interfaces, the mathematical model is fed with the information related to the original sub-domains of the problem, and then the Generalized Integral Transform Technique is employed for the hybrid numerical-analytical solution of the resulting mathematical problem. The present paper is aimed at further advancing this methodology, solving conjugated heat transfer for incompressible laminar gas flow in microchannels, within the range of validity of the slip flow regime. For verification purposes, a test problem on steady or quasi-steady state thermally developing convection is more closely considered, that still offers an exact solution though the classical integral transforms analysis. The results obtained indicate that the single domain reformulation can successfully deal with slip flow regime situations, once a fictitious material layer is introduced to account for the velocity slip and the temperature jump interface conditions.