

Numerical Simulation of Heat Transfer Enhancement due to a Gap in an Inclined Continuous Rib Arrangement in a Solar Air Heater Duct

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ABSTRACT

In the present work, numerical simulation has been carried out to investigate the effect of an inclined rib with a gap on the performance of a solar air heater duct. The geometry is numerically modeled and three-dimensional Navier-Stokes equation has been solved using a commercial code Ansys Fluent 14. 5 for the Reynolds number range of 3500 to 19, 000. The flow geometry of the rectangular duct has rectangular cross-section of 181 mm in width and 31 mm in height. The artificial roughness was generated using square ribs of 2 mm size having a gap with fix roughness parameters, namely relative roughness height (e/D_h) of 0. 037, relative pitch (P/e) of 8, relative gap position (g/W) of 0. 25, relative gap width (g/e) of 1. 0 and relative roughness angle (α) of 60° . The absorber plate is heated with a constant heat flux of 1000 W/m^2 keeping in view of the heat generated by incidence solar radiation. The effect of the roughness geometry on heat transfer and flow field characteristics of the duct has been investigated numerically. The boundary layer elements were attached near the heating wall and total hexahedral elements of around 2. 1 million are used based on grid independency analysis. Different turbulent models are used and their results are compared. Realizable $k-\epsilon$ model with standard wall treatment showed good agreement with available experimental results. The comparison of numerical results with the experimental results shows the deviation in the range of 3-20% for Nusselt number for the range of investigation.

Keywords: Solar air heater duct, heat transfer, artificial roughness, computational fluid dynamics, turbulence

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Heat Transfer Enhancement Using Nanofluid Flow in Microchannels Davood Domairry Ganji, Amir Malvandi, 2016-06-11 Heat Transfer Enhancement Using Nanofluid Flow in Microchannels Simulation of Heat and Mass Transfer focuses on the numerical simulation of passive techniques and also covers the applications of external forces on heat transfer enhancement of nanofluids in microchannels Economic and environmental incentives have increased efforts to reduce energy consumption Heat transfer enhancement augmentation or intensification are the terms that many scientists employ in their efforts in energy consumption reduction These can be divided into a active techniques which require external forces such as magnetic force and b passive techniques which do not require external forces including geometry refinement and fluid additives Gives readers the knowledge they need to be able to simulate nanofluids in a wide range of microchannels and optimise their heat transfer characteristics Contains real life examples mathematical procedures numerical algorithms and codes to allow readers to easily reproduce the methodologies covered and to understand how they can be applied in practice Presents novel applications for heat exchange systems such as entropy generation minimization and figures of merit allowing readers to optimize the techniques they use Focuses on the numerical simulation of passive techniques and also covers the applications of external forces on heat transfer enhancement of nanofluids in microchannels **Numerical Simulation of Heat Transfer Enhancement Resulting from a Streamwise Vortex Embedded in Laminar and Turbulent Boundary Layer Flows** David Shan-Ming Wang, 1994 Numerical Simulation of Convection in Electronic Equipment Cooling American Society of Mechanical Engineers. Winter Annual Meeting, 1989 **Numerical Heat Transfer with Personal Computers and Supercomputing** R. K. Shah, 1989 Applied Mechanics And Mechanical Engineering Hong Hua Tan, 2010-08-13 Selected peer reviewed papers from the 2010 International Conference On Applied Mechanics And Mechanical Engineering ICAMME 2010 September 8 9 2010 Changsha China **Recent Advances in Thermal Sciences and Engineering** Hemant B. Mehta, Manish K. Rathod, Rufat Abiev, Müslüm Arıcı, 2023-05-05 This book presents select proceedings of the International Conference on Advances in Fluid Flow and Thermal Sciences ICAFFTS 2021 and summarizes the modern research practices in thermal sciences and engineering The content of book involves advanced topics in heat transfer science automobile refrigeration and air conditioning cryogenics non conventional systems and energy storage Topics on cutting edge research in the area of hybrid nano PCM based systems solar based applications bio diesel and nano additives based combustion fuel cell and thermoacoustic engine are also included In addition this book contains recent research in the area of two phase thermal management of Li Ion Li titanium battery and LED systems using heat sink heat pipe pulsating heat pipe and thermosyphon with next generation refrigerants PCM and nanofluid Some thermal aspects of virus aerosol research advances in volumetric velocimetry and application of artificial intelligence in thermal systems are also covered This book is a valuable reference for academicians researchers and professionals working in the various fields of

thermal sciences **Applications of Semi-Analytical Methods for Nanofluid Flow and Heat Transfer** Mohsen Sheikholeslami, Davood Domairry Ganji, 2018-01-02 Application of Semi Analytical Methods for Nanofluid Flow and Heat Transfer applies semi analytical methods to solve a range of engineering problems After various methods are introduced their application in nanofluid flow and heat transfer magnetohydrodynamic flow electrohydrodynamic flow and heat transfer and nanofluid flow in porous media within several examples are explored This is a valuable reference resource for materials scientists and engineers that will help familiarize them with a wide range of semi analytical methods and how they are used in nanofluid flow and heat transfer The book also includes case studies to illustrate how these methods are used in practice Presents detailed information giving readers a complete familiarity with governing equations where nanofluid is used as working fluid Provides the fundamentals of new analytical methods applying them to applications of nanofluid flow and heat transfer in the presence of magnetic and electric field Gives a detailed overview of nanofluid motion in porous media

Advances in Computational Fluid Dynamics Basma Souayeh, Katta Ramesh, 2025-11-17 Advances in Computational Fluid Dynamics delves into the emergent ways that engineers are utilizing computer simulations to enhance efficiency reduce costs and innovate across aerospace automotive energy and biomedical engineering fields It provides the most recent tools and strategies for improving prediction accuracy design and optimization Highlighting the practical uses of computational fluid dynamics CFD in solving real world engineering issues the book covers a wide range of physical problems from turbulence modeling and high performance computing to the integration of machine learning and multiphysics simulation It includes case studies in aerodynamic designs energy conversion processes and cooling systems and examines AI integration and machine learning techniques The book will interest researchers upper level undergraduate and graduate engineering students studying practical applications of CFD

Localized Energy Transition in the 4th Industrial Revolution Opeyeolu Timothy Laseinde, Andrew C. Eloka-Eboka, 2024-10-24 This book presents a holistic view on localized energy transition while addressing current challenges associated with the production of biofuels introducing new materials to produce solar photovoltaic PV panels and digital systems for sustainable energy monitoring on a small scale carbon capture and sequestration Also each chapter of the book addresses specific aspects of the renewable and sustainable energy space while focusing more on energy improvement and storage technologies that are practical focused Features Offers useful information on new forms of renewable energy generation with reference to Industry 4.0 Illustrates practical approaches to energy transition Provides guidance on renewable energy sources and energy storage systems Discusses the application of the Fourth Industrial Revolution 4IR related approaches to emerging energy storage technologies Includes studies that reveal approaches to realizing productivity profitability and increased return on investment ROI This book is aimed at graduate students and researchers in mechanical chemical and mechatronics engineering and renewable energy systems *Applied*

Mechanics Reviews, 1992 **Applied Decisions in Area of Mechanical Engineering and Industrial Manufacturing**

Kuang Chao Fan,2014-07-04 Selected peer reviewed papers from the 3rd International Conference on Mechanical Control and Electronic Information ICMCEI 2014 June 27 29 2014 Taiwan **Journal of Heat Transfer** ,2008 Chaos in Heat Transfer and Fluid Dynamics Vedat S. Arpaci,1994 **Nanofluid in Heat Exchangers for Mechanical Systems** Zhixiong Li,Ahmad Shafee,Iskander Tlili,M. Jafaryar,2020-04-08 Nanofluid in Heat Exchanges for Mechanical Systems Numerical Simulation shows how the finite volume method is used to simulate various applications of heat exchanges Heat transfer enhancement methods are introduced in detail along with a hydrothermal analysis and second law approaches for heat exchanges The melting process in heat exchanges is also covered as is the influence of variable magnetic fields on the performance of heat exchange This is an important reference source for materials scientists and mechanical engineers who are looking to understand the main ways that nanofluid flow is simulated and applied in industry Towards Nanofluids for Large-Scale Industrial Applications Bharat A. Bhanvase,Divya Barai,Gaweł Zyla,Zafar Said,2024-05-03 Nanofluids for Large Scale Industrial Applications examines the challenges and current progress towards large scale industrial application of nanofluids summarizing and bringing together varied current research strands and providing potential solutions pertaining to the scientific economic and social barriers that currently exist Opening with an introduction to nanofluid synthesis types and properties this book traverses the potential large scale applications and commercialisation of nanofluids in industrial heating cooling solar energy systems refrigeration systems automotive systems and various chemical processes and manufacturing systems This book provides knowledge of a vast area of applications of nanofluids in industries Thus it also has potential to encourage and trigger the minds of researchers to discover more about nanofluids investigate the gaps overcome the challenges and provide future directions for newer applications and develop nanofluids further The book is written chiefly for graduate postdoc level students and researchers academics teaching or studying in chemical and thermal engineering and who are focused on heat transfer enhancement thermal energy nanofluids and nano enhanced energy systems such as solar thermal systems Examines the challenges and current progress towards implementing large scale industrial application of nanofluids Addresses current gaps in research explores challenges and controversies as well as weaknesses and strengths versus alternative solutions Aims to bridge the gap between fundamental research and potential industrial scale utilization in the future by providing pathways towards convenient and sustainable scale up Meets a need to compile all current information and knowledge from studies and research related to large scale nanofluids applications in one single resource **Advances in Heat Transfer** Ephraim M. Sparrow,John Patrick Abraham,John M. Gorman,Young I. Cho,2014-11-26 Advances in Heat Transfer fills the information gap between regularly scheduled journals and university level textbooks by providing in depth review articles over a broader scope than in journals or texts The articles which serve as a broad review for experts in the field will also be of great interest to non specialists who need to keep up to date with the results of the latest research This serial is essential reading for all mechanical chemical and industrial engineers working in

the field of heat transfer graduate schools or industry Never before have so many authorities provided both retrospective and current overviews Electrostatics ,1987 **Electrostatics 1987, Invited and Contributed Papers from the Seventh INT Conference on Electrostatic Phenomena, Oxford, April 1987** J. L. Sproston,1987 The Seventh International Conference on Electrostatics was held at St Catherine s College Oxford from 8 10 April 1987 The conference attracted delegates form no fewer than 16 countries and over 50 papers were presented These proceedings contain 57 invited and contributed papers including the Bill Bright Memorial Lecture which opened the conference The proceedings are arranged in several sections which reflect the organisation of the conference applications hazards simulation and fundamentals poster session electrostatic damage and related effects hazards applications measurements and testing poster session and measurements and fundamentals Transcription of the discussions which took place after each session are also included These proceedings therefore provide a valuable overview of the most recent developments in electrostatics and point the way towards areas of future research **1998 IEEE Conference on Electrical Insulation and Dielectric Phenomena** ,1998-10 This work discusses research done in dielectric phenomena and measurements Contents include ageing dielectrics surface flashover polarization phenomena and measurement techniques Bulletin de L'Institut International Du Froid ,2008

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