

EGM

Entropy Generation Minimization

EGM is a design concept based upon minimization of irreversible processes. It is a new philosophy: **reversible processes are good, irreversible wrong**.

As a measure of irreversibility the rate of entropy generation in a system is considered. Entropy increase is caused by heat transfer from high to low temperatures (this is always irreversible process) and also by hydrodynamics, by frictional losses (conversion of mechanical energy to heat by friction is also irreversible). These two causes can be summarized for the case of continuous fluid flow (general temperature and flow velocity distribution in space) as

$$\dot{S}_{gen} = \lambda \left(\frac{\nabla T}{T} \right)^2 + \frac{\vec{\tau} : \nabla \vec{u}}{T}$$

Rate of entropy
increase in unit
volume $\frac{W}{m^3 K}$

Irreversibility due to heat
conduction. λ is thermal
conductivity. See also
previous expression

$$ds = dq \frac{T_1 - T_2}{T_1 T_2}$$

Scalar product of viscous
stress tensor τ and
gradient of velocity u is
power dissipated to heat
in unit volume

Entropy Generation Minimization Entropy Generation Minimization

Ubaidullah Selamat



Entropy Generation Minimization Entropy Generation Minimization:

Entropy Generation Minimization Adrian Bejan, 1995-10-20 This book presents the diverse and rapidly expanding field of Entropy Generation Minimization EGM the method of thermodynamic optimization of real devices The underlying principles of the EGM method also referred to as thermodynamic optimization thermodynamic design and finite time thermodynamics are thoroughly discussed and the method's applications to real devices are clearly illustrated The EGM field has experienced tremendous growth during the 1980s and 1990s This book places EGM's growth in perspective by reviewing both sides of the field engineering and physics Special emphasis is given to chronology and to the relationship between the more recent work and the pioneering work that outlined the method and the field Entropy Generation Minimization combines the fundamental principles of thermodynamics heat transfer and fluid mechanics EGM applies these principles to the modeling and optimization of real systems and processes that are characterized by finite size and finite time constraints and are limited by heat and mass transfer and fluid flow irreversibilities Entropy Generation Minimization provides a straightforward presentation of the principles of the EGM method and features examples that elucidate concepts and identify recent EGM advances in engineering and physics Modern advances include the optimization of storage by melting and solidification heat exchanger design power from hot dry rock deposits the on the production of ice and other solids the maximization of power output in simple power plant models with heat transfer irreversibilities the minimization of refrigerator power input in simple models and the optimal collection and use of solar energy

Entropy Generation Minimization Adrian Bejan, 2013-10-29 This book presents the diverse and rapidly expanding field of Entropy Generation Minimization EGM the method of thermodynamic optimization of real devices The underlying principles of the EGM method also referred to as thermodynamic optimization thermodynamic design and finite time thermodynamics are thoroughly discussed and the me *Entropy Generation Minimization for Fluctuating Flows* Ubaidullah Selamat, 2011 *A Critical Perspective of Entropy Generation Minimization in Thermal Analyses and Optimizations* XueTao Cheng, 2018-10-29 Thermal analyses and optimizations are very ubiquitous and important in academic research and engineering applications In this field the entropy generation minimization has been widely used and found to be effective in many cases Sometimes it was even used without checking the applicability and seemed to be a unified theory that could solve all thermal problems Is this really the case This book answers this question through detailed theoretical derivations and different numerical examples in heat transfer and heat work conversion It shows clearly that the theory has limitations and a definite application scope beyond which it may provide unreasonable or incorrect results Therefore the entropy generation minimization is far from perfect This book will be of interest to students researchers and engineers in thermal science and engineering as it will help the reader to apply the entropy generation minimization correctly *Reliability of Heat Sink Optimization Using Entropy Generation Minimization* Takahiro Furukawa, 2002 **Entropy Generation Minimization of a Heat and Mass**

Exchanger for Use in a Humidification-dehumidification Desalination System Gregory P. Thiel, Massachusetts Institute of Technology. Department of Mechanical Engineering, 2012 The physical mechanisms of entropy generation in a condenser with high fractions of non condensable gases are examined using control volume scaling and boundary layer techniques with the aim of defining a criterion for minimum entropy generation rate that is useful in engineering analyses This process is particularly relevant in humidification dehumidification desalination systems where minimizing entropy generation per unit water produced is critical to maximizing system performance Control volume techniques are first employed and shown to be ill suited to understanding why and how balancing a heat and mass exchanger minimizes entropy generation As a result a more complex boundary layer model is introduced the process is modeled by a consideration of the vapor gas boundary layer alone as it is the dominant thermal resistance and consequently the largest source of entropy production in many practical condensers with high fractions of non condensable gases Most previous studies of condensation have been restricted to a constant wall temperature but it is shown here that for high concentrations of non condensable gases a varying wall temperature obtained from balancing the heat and mass exchanger greatly reduces total entropy generation rate Further it is found that the diffusion of the condensing vapor through the vapor non condensable mixture boundary layer is the larger and often dominant mechanism of entropy production in such a condenser As a result when seeking to design a unit of desired heat transfer and condensation rates for minimum entropy generation minimizing the variance in the driving force associated with diffusion yields a closer approximation to the minimum overall entropy generation rate than does equipartition of temperature difference Finally a rigorous and general definition of balancing for any heat and mass exchanger is discussed

Entransy XueTao Cheng, 2023-05-25 In this book the author introduces an alternative perspective to understand thermal phenomena the concept of entransy and its relevant principles applications and extensions which have been widely used in the analyses and optimizations of many transport processes The scientific significance and application value of the theory have been clearly demonstrated The theory is inevitably questioned and there are even accusations that are not academically valid These controversies are also introduced and discussed comprehensively This book is an introduction to the entransy theory the author has only selected a few cases that are sufficient to show the advantages and necessity of the application of the theory This book is helpful to the undergraduates graduates teachers engineers scientists and researchers in thermal science and engineering

Advances in Transport Phenomena 2011 Liquu Wang, 2013-10-07 This new volume of the annual review Advances in Transport Phenomena series contains three in depth review articles on the microfluidic fabrication of vesicles the dielectrophoresis field flow fractionation for continuous flow separation of particles and cells in microfluidic devices and the thermodynamic analysis and optimization of heat exchangers respectively

Optimization of Heat Sinks with Flow Bypass Using Entropy Generation Minimization [electronic Resource] HOSSAIN, MD RAKIB, 2006

Energy and the Environment Adrian Bejan, Peter Vadász, Detlev G. Kröger, 1999 This book

describes the state of the art at the interface between energy and environmental research The contributing authors are some of the world leaders in research and education on energy and environmental topics The coverage is worth noting for its breadth and depth The book begins with the latest trends in applied thermodynamics the methods of exergy analysis entropy generation minimization and thermoeconomics It continues with the most modern developments in energy processing and conservation techniques heat transfer augmentation devices inverse thermal design combustion and heat exchangers for environmental systems The environmental impact of energy systems is documented in a diversity of applications such as the flow of hazardous waste through cracks and porous media thermally induced flows through coastal waters near power plants and lake ecology in the vicinity of pumped storage systems The book outlines new research directions such as the manufacturing of novel materials from solid waste advances in radiative transport the measurement of convective heat transfer in gas turbines and environmentally acceptable refrigerants The book is rich in engineering design data that make a concrete statement on topics of world wide interest e g toxic emissions the depletion of energy resources global environmental change global warming and future trends in the power generation industries Written by leaders in research and education this book is an excellent text or supplement for undergraduate and graduate courses on energy engineering and environmental science

Optimization of a Circular Microchannel Heat Sink Using Entropy Generation Minimization Method Arash Jafari, 2009 **ECOS 2012 The 25th International Conference on Efficiency, Cost, Optimization and Simulation of Energy Conversion Systems and Processes (Perugia, June 26th-June 29th, 2012)**

Umberto Desideri, Enrico Sciubba, Giampaolo Manfrida, 2012 The 8 volume set contains the Proceedings of the 25th ECOS 2012 International Conference Perugia Italy June 26th to June 29th 2012 ECOS is an acronym for Efficiency Cost Optimization and Simulation of energy conversion systems and processes summarizing the topics covered in ECOS Thermodynamics Heat and Mass Transfer Exergy and Second Law Analysis Process Integration and Heat Exchanger Networks Fluid Dynamics and Power Plant Components Fuel Cells Simulation of Energy Conversion Systems Renewable Energies Thermo Economic Analysis and Optimisation Combustion Chemical Reactors Carbon Capture and Sequestration Building Urban Complex Energy Systems Water Desalination and Use of Water Resources Energy Systems Environmental and Sustainability Issues System Operation Control Diagnosis and Prognosis Industrial Ecology

Effective Techniques for Augmenting Heat Transfer: An Application of Entropy Generation Minimization Principles Adrian

Bejan, COLORADO UNIV AT BOULDER DEPT OF MECHANICAL ENGINEERING., 1980 The techniques for heat transfer augmentation play an important role in the development of efficient and inexpensive equipment for heat exchange processes In the present study the effectiveness of a given augmentation technique was determined based on the amount of irreversibility waste of useful energy introduced by the technique into the heat exchanger where it is to be used This report summarizes the main results obtained during the past two years under research contract N00014 79 C 0006 at the University

of Colorado The report is organized into three distinct parts The first part contains a fundamental investigation of the entropy generation mechanism in elementary heat transfer configurations The second part describes in quantitative terms the irreversibility minimization potential of some of the most common augmentation techniques namely swirl flow devices and roughened surfaces The final part considers the entropy generation penalty associated with the use of extended surfaces fins in convective heat transfer This part shows how the fin geometry may be selected so that the fin performs its prescribed heat transfer duty with minimum generation of entropy Author Nanofluids and Their Engineering Applications K.R.V. Subramanian, Tubati Nageswara Rao, Avinash Balakrishnan, 2019-06-18 Nanofluids are solid liquid composite material consisting of solid nanoparticles suspended in liquid with enhanced thermal properties This book introduces basic fluid mechanics conduction and convection in fluids along with nanomaterials for nanofluids property characterization and outline applications of nanofluids in solar technology machining and other special applications Recent experiments on nanofluids have indicated significant increase in thermal conductivity compared with liquids without nanoparticles or larger particles strong temperature dependence of thermal conductivity and significant increase in critical heat flux in boiling heat transfer all of which are covered in the book Key Features Exclusive title focusing on niche engineering applications of nanofluids Contains high technical content especially in the areas of magnetic nanofluids and dilute oxide based nanofluids Feature examples from research applications such as solar technology and heat pipes Addresses heat transfer and thermodynamic features such as efficiency and work with mathematical rigor Focused in content with precise technical definitions and treatment Optimization of Microelectronic Cooling Systems Using Minimization of Entropy Generation Stefan H. Berg, 2001 Proceedings of the ASME Advanced Energy Systems Division American Society of Mechanical Engineers. Advanced Energy Systems Division, 2007 *The Measurement, Prediction and Minimization of Viscous Entropy Generation in Transitional Boundary Layers* Edmond Walsh, 2002 **Transfer Phenomena in Fluid and Heat Flows XII** Stanislav Kolisnychenko, 2021-04-06 Special topic volume with invited peer reviewed papers only **Advanced Engineering Thermodynamics** Adrian Bejan, 1997 The first law of thermodynamics The second law of thermodynamics The two laws combined the destruction of exergy Single phase systems Exergy analysis Multiphase systems Chemically reactive systems Power generation Solar power Refrigeration Thermodynamic optimization Irreversible thermodynamics Constructal theory of organization in nature **Proceedings of the ASME Heat Transfer Division**, 2007

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