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PLENARY LECTURE

Uniqueness and Universality of Heat Transfer:

*Challenges and Opportunities for Improving Heat Transfer Processes -
The Quest and Nature of Energy, Heat and Entropy*



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Abstract

This presentation focuses on philosophical and practical aspects of energy, heat and entropy, with emphasis on reversibility and irreversibility, and a goal to establish the concept of ideal “*reversible heat transfer*,” regardless that heat transfer is a typical irreversible process. Heat transfer, like any other energy transfer, may be achieved from any-to-any temperature level, and in limit be reversible, if temperature of an intermediary cyclic substance is adjusted as needed, using isentropic compression and expansion. The reversible heat transfer limits are the most efficient and demonstrate limiting potentials for practical heat transfer processes.

The heat transfer and thermal energy are unique and universal manifestation of all natural and artificial (man-made) processes, and thus are vital for more efficient cooling and heating in new and critical applications, including energy production and utilization, environmental control and cleanup, and bio-medical applications. Heat transfer is known as typical spontaneous irreversible process where all organized (structural) energies are disorganized or dissipated as thermal energy with irreversible loss of energy potential (from high to low temperature) and overall entropy increase. However, since reversible adiabatic expansion and compression change thermal-potential (temperature) without heat transfer, it makes possible to have reversible heat transfer from one thermal potential to either lower or higher, using reversible refrigeration or combined dual, power-and-heat-pump cycles, respectively, with overall increase in efficiency.

Author Biography:

Professor Kostic's teaching and research interests are in Thermodynamics (*a science of energy, the Mother of All Sciences*), Fluid Mechanics, Heat Transfer and related fluid-thermal-energy sciences; with emphases on physical comprehension and creative design, experimental methods with computerized data acquisition, and CFD simulation; including nanotechnology and development of new-hybrid, POLY-nanofluids with enhanced properties, as well as design, analysis and optimization of fluids-thermal-energy components and systems in power-conversion, utilizations, manufacturing and material processing. Dr. Kostic came to Northern Illinois University from the University of Illinois at Chicago, where he supervised and conducted a two-year research program in heat transfer and viscoelastic fluid flows, after working for some time in industry.

"Kostic's unique synergy of philosophical, theoretical, computational and experimental approach, results in open mind, intense curiosity and sharp focus for identifying and analyzing natural and engineering phenomena with high motivation for problem identification, troubleshooting and solving."

Kostic received his B.S. degree with the [University of Belgrade](#) Award as the best graduated student in 1975. Then he worked as a researcher in thermal engineering and combustion at [The Vinca Institute for Nuclear Sciences](#), which then hosted the headquarters of the [International Center for Heat and Mass Transfer](#), and later taught at the University of Belgrade in ex-Yugoslavia (*). He came to the [University of Illinois at Chicago](#) in 1981 as a Fulbright grantee, where he received his Ph.D. in mechanical engineering in 1984. Subsequently, Dr. Kostic worked several years in [industry](#). In addition, he spent three summers as an exchange visitor in England, West Germany, and the former Soviet Union.

Dr. Kostic has received recognized professional fellowships and awards, including multiple citations in [Marquis' "Who's Who in the World"](#) and ["Who's Who in Science and Engineering."](#); the [Fulbright Grant](#); [NASA Faculty Fellowship](#); Sabbatical Semester at [Fermilab](#) as a [Guest Scientist](#); and the summer [Faculty Research Participation Program](#) at [Argonne National Laboratory](#). He is a frequent reviewer of professional works and books in Thermodynamics and Experimental Methods. Dr. Kostic is a licensed [professional engineer \(PE\)](#) in Illinois and a member of the [ASME](#), [ASEE](#), and [AIP's Society of Rheology](#). He has a number of [publications](#) in refereed journals, including invited state-of-the-art chapters in the [Academic Press](#) series [Advances in Heat Transfer, Volume 19](#), and ["Viscosity" in CRC Press' Measurement, Instrumentation and Sensors Handbook](#); as well as invited reference articles: [Work, Power, and Energy in Academic Press/Elsevier's Encyclopedia of Energy](#); [Extrusion Die Design](#) in Dekker's [Encyclopedia of Chemical Processing](#); and [Energy: Global and Historical Background](#) and [Physics of Energy](#) in Taylor & Francis/CRC Press [Encyclopedia of Energy Engineering and Technology](#). Professor Kostic is a member of the Graduate Faculty at [Northern Illinois University](#).

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