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High-Resolution RBF-based Finite Volume Methods for Conservation Laws on Unstructured Grids

Dr.Faranak Gholampour

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Energy Transfers in Atmosphere and Ocean
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Abstract:

This project concerns numerical approaches that can effectively solve hyperbolic conservation laws with arbitrarily high accuracy. Finite Volume methods are well-suited for solving conservation laws; however, the classical approaches are often of low order. Hence, high-resolution versions have been developed to handle spurious oscillations caused by sharp gradients or discontinuities of the solution, leading to prevent degradation of the approximation quality. It has been found that the use of linear reconstruction operators such as least-squares reconstruction on a single stencil can offer high order of accuracy even on unstructured grids. High-order polynomial reconstructions are commonly used in a stencil surrounding a control volume to approximate solution over a desired control volume. to address the numerical instabilities of polynomial reconstructions, we use the kernel-based interpolation method, using radial basis functions. This method can be applied in any spatial dimension, offering enhanced flexibility in stencil selection, particularly on unstructured grids. Such features also simplify stencil selection for the high-order non-oscillatory and weighted ENO reconstruction schemes. In this talk, the proposed high-resolution methods using vertex-centered (median-dual) control volumes on unstructured grids are discussed.

Lecture Link:
http://el.sutech.ac.ir/rst8lzha5087

SATURDAY May 11, 2024 (22/02/1403)
19:00 – 20:00

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Workplace Absenteeism due to COVID-19 and Influenza: A Mathematical Model

Dr.Rahele Mosleh

Postdoctoral Fellow at Laboratory of Industrial and Applied Mathematics, Department of Mathematics and Statistics, Faculty of Science, York University, Toronto, Canada

Abstract:

The continual distress of COVID-19 cannot be overemphasized. The pandemic economic and social costs are alarming, with recent attributed economic loss amounting to billions of dollars globally. This economic loss is partly driven by workplace absenteeism due to the disease. Influenza is believed to be a culprit in reinforcing this phenomenon as it may exist in the population concurrently with COVID-19 during the influenza season. Furthermore, their joint infection may increase workplace absenteeism leading to additional economic loss. The objective of this project will aim to quantify the collective impact of COVID-19 and influenza on workplace absenteeism via a mathematical compartmental disease model incorporating population screening and vaccination. The results indicate that appropriate PCR testing and vaccination of both COVID-19 and seasonal influenza may significantly alleviate workplace absenteeism. However, with COVID-19 PCR testing, there may be a critical threshold where additional tests may result in diminishing returns. Regardless, it is recommended on-going PCR testing as a public health intervention accompanying concurrent COVID-19 and influenza vaccination with the added caveat that sensitivity analyses will be necessary to determine the optimal thresholds for both testing and vaccine coverage. Overall, the results suggest that rates of COVID-19 vaccination and PCR testing capacity are important factors for reducing absenteeism, while the influenza vaccination rate and the transmission rates for both COVID-19 and influenza have lower and almost equal affect on absenteeism. We also use the model to estimate and quantify the (indirect) benefit that influenza immunization confers against COVID-19 transmission

SUNDAY May 12, 2024 (23/02/1403) 19:00- 20:00

Link Lecture: http://el.sutech.ac.ir/rst8lzha5087

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Application of Mathematics in Nanotechnology Focusing on Optimal Shape Design

Fatemeh Gholampour

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Abstract:
Nanoparticles exhibit distinctive optical characteristics that hold significant potential for enhancing the performance of optical devices. Accordingly, the dimensions, shape, composition, and arrangement of nanoparticles constitute influential factors, with the optimization of each being deemed a crucial stride in advancing nanoparticle-based technologies. This lecture aims to introduce nanoparticles and their diverse applications, while also furnishing several illustrative instances of mathematical methodologies utilized to address challenges within the optics industry. A comprehensive mathematical model is presented herein to ascertain the optimal nanoparticle shape for various optical device applications. Furthermore, a succinct exposition shape-measure method in cylindrical coordinates, along with its associated advantages, is provided, followed by a detailed elucidation of its application in determining the optimal nanoparticle shape within solar cells. The findings of this research hold implications beyond their immediate context, extending to potential applications in industrial and medical domains, thereby laying the groundwork for further interdisciplinary exploration.

Lecture Link: http://el.sutech.ac.ir/rst8lzha5087

MONDAY May 13, 2024 (24/02/1403) 19:00- 20:00