Numerical methods for partial differential equations and real-life applications

Organizers:
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Abstract

Partial differential equations (PDEs) are encountered in several areas of engineering, applied science, finance, and biology. Most of these PDEs cannot be solved analytically; hence, the need for numerical techniques for solving them continue to be vital. Numerical methods for solving parabolic, hyperbolic, and elliptic PDEs will be discussed. Some of the methods will be applied to well-known problems in the literature such as the Non-linear Schröndinger equation and the one-dimensional reaction-diffusion equation.

Session 1:

- **Speaker:** *Samuel N. Jator*, (Jators@apsu.edu), Department of Mathematics and Statistics, Austin Peay State University, Clarksville, TN 37044; Fidele F. Ngwane (fifonge@yahoo.com), Department of Mathematics, USC Salkehatchie, SC

  Title: L-stable block hybrid second derivative algorithm for parabolic partial differential equations

  Abstract: A block method based on a hybrid second derivative algorithm (BHSDA) is provided by a continuous scheme and used to solve parabolic partial differential equations. The application of the BHSDA is facilitated by the method of lines which involves making an approximation to the space derivatives, and hence reducing the problem to a time - dependent system of initial value ordinary differential equations. The stability properties of the method is examined and some numerical results presented.

- **Speaker:** *Xiao Liang*, (xl2h@mtmail.mtsu.edu), Abdul Q. M. Khaliq (Abdul.Khaliq@mtsu.edu), Department of Mathematical Sciences and Center for Computational Science Middle Tennessee State University Murfreesboro, TN 37132; Yulong Xing, (xingy@math.utk.edu), University of Tennessee and Oak Ridge National Laboratory, Knoxville, TN

  Title: Efficient Exponential Time Differencing Methods for the Systems of Non-linear Schröndinger equations

  Abstract: We employ the Exponential Time Differencing methods in temporal discretization for solving the systems of non-linear Schrdinger equations. Spatial approximations including a quartic spline and Discontinuous Galerkin methods are discussed. Stability and energy conservation properties of the methods are shown. The efficiency and reliability of the methods are compared with the existing methods in the literature.

- **Speaker:** *Justin Oelgoetz*, (oelgoetzj@apsu.edu), Department of Physics and Astronomy Austin Peay State University PO Box 4608 Clarksville, TN 37044

  Title: PDEs in Physics: A select review of the physics described by some important PDEs, and some notes on numerically solving them

Abstract: Partial Differential Equations describe many of the real-life phenomena around us. Some of equations are simple, others are quite complex. This talk will review some of the PDEs common in physics and the phenomena they govern as well as provide some notes on some algorithms that are used to find numerical solutions.

- **Speaker:** *Daniel J. Galiffa*, (djg34@psu.edu), Department of Mathematics, Penn State Erie, The Behrend College, 4205 College Drive, Erie, PA 16563

  Title: Nonlocal Modeling of Physical Phenomena: Past, Present & Future

  Abstract: In this talk, we address how the nonlocal structure $\alpha\left(\int_{\Omega} u(x)dx\right)$ has played an important role in the development and analysis of mathematical models in thermodynamics (thermodynamic equilibrium via Coulomb potential) and in epidemiology (insect borne diseases). We further discuss the development of new models that arise from the aforementioned ones, which have applications to both epidemics and pandemics.