2019 南區科學計算、微分方程與應用研討會

會議手冊

研討會時間：2019 年 2 月 15 日 (週五)

地點：國立中山大學理學院四樓會議室

主旨與目標:

　　『南區科學計算、微分方程與應用研討會』自 2010 起，每年分別由南台灣包括了: 高雄大學、成功大學、中山大學、台南大學、嘉義大學、中正大學與虎尾科技大學等七所大學輪流主辦。基於近年來，南臺灣年輕新進的科學研究人才日益增多，為了促成彼此研究心得的交流與成果的分享，在每年二月份新學期開學前，定期舉辦『南區科學計算、微分方程與應用研討會』。

　　盼望在過去幾年南區逐漸成形的研究合作隊伍的基礎上，這次的研討會能夠提供更多的交流平台，協助台灣南區從事科學計算與微分方程研究人員整合並且加強合作關係。

議　　　　程

時　間	演　講　者	主　　題	頁數
2019/2/15 (Friday)			
9:00-9:30		Opening	
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11:00-11:30	劉青松	The numerical methods for nonlinear eigenvalue problems	5
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14:00-14:30	王辰樹	Regularization of Extended Kalman Filtering	7
14:30-15:00	吳宗芳	Multiple positive solutions of saturable nonlinear Schrodinger equations with intensity functions	8
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15:30-16:00	郭岳承	A structure preserving flow for computing Hamiltonian matrix exponential	9
16:00-16:30	黃印良	Coexistence and semi-exact solutions for Lotka-Volterra systems of two competing species in spatially periodic habitats	10
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Theory of two species competition in ordered Banach Spaces

許世壁

國立清華大學

Abstract

The Lotka-Volterra two species competition model is a well-known mathematical model in population biology. In this talk we shall consider a generalization of the LV model. The dynamics of competitive maps and semi-flows defined on the product of two cones in respective Banach spaces

Is studied. It is shown that exactly one of three outcomes is possible for the two viable competitors. Either one or the other population becomes extinct while the surviving population approaches a steady state, or there exists a positive steady state representing the coexistence of both populations.

Many of the mathematical models of two competing species modeled in ODE, PDE and FDE will be fitted in this framework. Two examples are given. One is a PDE model of two identical species except in dispersal rate , competing in a heterogeneous environments. The other is a PDE model of two micro-organisms competing for a single-limited nutrient in an unstirred chemostat.

The numerical methods for nonlinear eigenvalue problems

劉青松

國立高雄大學

Abstract

In this talk, we will introduce nonlinear eigenvalue problems that include tensor eigenvalue problems and nonlinear Schrödinger equations. And we will discuss its numerical methods and some numerical results.

An accelerated technique for solving some structured matrix equations

蔣俊岳

國立虎尾科技大學

Abstract

Nonlinear matrix equations play a crucial role in science and engineering problems. However, solutions of nonlinear matrix equations cannot, in general, be given analytically. One standard way of solving nonlinear matrix equations is to apply the fixed-point iteration with usually only the linear convergence rate. To advance the existing methods, we exploit in this work one type of semigroup property and use this property to propose a technique for solving the equations with the speed of convergence of any desired order. We realize our way by starting with examples of solving the scalar equations and, also, connect this method with some well-known equations including, but not limited to, the Stein matrix equation, the generalized eigenvalue problem, the generalized nonlinear matrix equation, the discrete-time algebraic Riccati equations to express the capacity of this method.

Regularization of Extended Kalman Filtering

王辰樹

國立成功大學

Abstract

The main shortcoming of extended Kalman filtering for nonlinear problems is that the detectability of the target system can not be always kept so that Kalman filtering can not be worked efficiently. To overcome this drawback, in this talk, we construct a detectable system by using driving-response synchronization. Then whenever we use Kalman filtering to track the signals of the new system, the signals of the original system are also figured out simultaneously.

Multiple positive solutions of saturable nonlinear Schrodinger equations with intensity functions

吳宗芳

國立高雄大學

Abstract

In this talk, we will study a class of nonlinear Schrodinger equation with saturable nonlinearity. By means of the Nehari manifold and the Lusternik Schnirelman category, multiple bound state solutions are obtained.

A structure preserving flow for computing Hamiltonian matrix exponential

郭岳承

國立高雄大學

Abstract

This article focuses on computing Hamiltonian matrix exponential. Given a Hamiltonian matrix $\mathcal{H}$, it is well-known that the matrix exponential $e^{\mathcal{H}}$ is a symplectic matrix and its eigenvalues form reciprocal $(\lambda, 1/\bar{\lambda})$. It is important to take care of the symplectic structure for computing $e^{\mathcal{H}}$. Based on the *structure-preserving flow* preposed by [1], we develop a numerical method for computing the symplectic matrix pair $(\mathcal{M}, \mathcal{L})$ which represents $e^{\mathcal{H}}$.

Coexistence and semi-exact solutions for Lotka-Volterra systems of two competing species in spatially periodic habitats

黃印良

國立台南大學

Abstract

We are concerned with the coexistence states of the diffusive Lotka-Volterra system of two competing species when the growth rates of the two species depend periodically on the spacial variable. For the one-dimensional problem, we employ the generalized Jacobi elliptic function method to find semi-exact solutions under certain conditions on the parameters. In addition, we use the sine function to construct a pair of upper and lower solutions and obtain a solution of the above-mentioned system. Next, we provide a sufficient condition for the existence of pulsating fronts connecting two semi-trivial states by applying the abstract theory regarding monotone semiflows. Some numerical simulations are also included.

Learning Convolutional Sparse Representation

彭冠舉

國立中興大學

Abstract

Convolutional sparse coding (CSC) is a useful tool in many image and audio applications. Maximizing the best performance of CSC requires that the dictionary used to store the features of signals be learned from real data. This so-called convolution dictionary learning (CDL) problem is formulated within a non-convex non-smooth optimization framework. Most existing CDL solvers alternately update the coefficients and dictionary in an iterative manner. However, these approaches are prone to running redundant iterations, and their convergence properties are difficult to analyze. Moreover, most of those methods approximate the original non-convex sparse inducing function using a convex regularizer to promote computational efficiency. This approach to approximation may result in non-sparse representations and thereby hinder the performance of the applications. In this paper, we deal with the non-convex nonsmooth constraints of the original CDL directly using the modified forward-backward splitting approach, in which the coefficients and dictionary are simultaneously updated in each iteration. We also propose a novel parameter adaption scheme to increase the speed of the algorithm used to obtain a usable dictionary and in so doing prove convergence. We also show that the proposed approach is applicable to parallel processing to reduce the computing time required by the algorithm to achieve convergence. Experiment results demonstrate that our method requires less time than existing methods to achieve the convergence point, while using a smaller final functional value. We also applied the dictionaries learned using the proposed and existing methods to an application involving signal separation. The dictionary learned using the proposed approach provides performance superior to that of comparable methods.