HKBU-NSYSU Workshop on Computational and Applied Mathematics
浸會中山計算與應用數學研討會

Date: April 9-10, 2007

Co-organised by: Department of Mathematics, Hong Kong Baptist University
Department of Applied Mathematics, National Sun Yat-sen University

Program

April 9, 2007 (Monday)

Place：Room 4009-1, Dept. of Applied Mathematics, National Sun Yat-sen University

Time	Speaker	Title
Session I: Computation		
08:50~09:00	**Opening Session**	
09:00~09:30	**湯濤 Tao TANG**	Recent Development in Scientific Computing
09:30~10:00	**布魯耐爾 海曼 Hermann BRUNNER**	The Numerical Analysis of Pantograph-type Volterra Functional Integral Equations
10:00~10:30	**Tea Break**	
10:30~11:00	**呂宗澤 Tzon-Tzer LU**	Trefftz, Collocation and Other Boundary Methods -- A Comparison
11:00~11:30	**黃杰森 Chien-Sen HUANG**	Fully Conservative Characteristic Methods for Transport Problems
11:30~12:00	**凌立雲 Leevan LING**	Point Sources Identification Problem for Heat Equations
12:00~14:00	**Lunch and Discussion**	**Future Exchange and Collaboration** **辦學經驗與交流合作座談**
14:00~14:30	**吳國寶 Kwok Po NG**	Inverse Filtering, Wavelet and TV Denoising for Image Restoration Problems
14:30~15:00	**徐洪坤 Hong-Kun XU**	Iterative Methods for Solving Constrained Linear Inverse Problems
15:00~15:30	**Tea Break**	
Session II: Combinatorics		
15:30~16:00	**邵慰慈 Wai Chee SHIU**	Edge-magic Labeling Matrices of the Composition of Paths with Null Graphs
16:00~16:30	**董立大 Li-Da TONG**	The Orientable Hull and Geodetic Numbers
16:30~17:00	**Tea Break**	
17:00~17:30	**陳偉康 Wai Hong CHAN**	On the Bandwidth and Cyclic Bandwidth Problems of Graphs
17:30~18:00	**潘志實 Zhi-Shi PAN**	Construction of Graphs with Given Circular Flow Number
18:00~19:00	**Dinner 晚宴**（英國領事館）	

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April 10, 2007 (Tuesday)

Place：Room 4009-1, Dept. of Applied Mathematics, National Sun Yat-sen University

Time	Speaker	Title
Session III: Statistics		
09:00~09:30	**鄧文禮 Man Lai TANG**	Testing the Non-unity of Rate Ratio under Inverse Sampling
09:30~10:00	**郭美惠 Mei-Hui GUO**	Monitoring Risk Factors of Heart Rate Variability for VICU Patients
10:00~10:30	**Discussion**	Exchange and Collaboration on Statistics
10:30~11:00	**Tea Break**	
11:00~12:30	**Discussion and Lunch**	**Future Exchange and Collaboration** **辦學經驗與交流合作座談**

Talk 1

Prof. Tao TANG 湯濤 教授
Dept of Mathematics, Hong Kong Baptist University
http://www.math.hkbu.edu.hk/~ttang

Title: Recent Development in Scientific Computing

Abstract:
Scientific Computing deals with the development of efficient and reliable algorithms for computations with floating-point numbers on computers, as well as the underlying theory related to the accuracy and stability of the algorithms. With the advance of modern high-performance computers, and in particular computers with parallel architecture, the implementation aspects have come to play a very useful role. Moreover, as the computational problems increase in size and complexity, the interplay between the mathematical modeling, the numerical algorithms, and the computer implementation becomes increasingly important. In this talk, the history of the scientific computing research will be reviewed and its current development will be introduced. The applications of scientific computing in several important areas such as computational fluid dynamics, scientific visualization and simulation of physical processes will be also discussed.

Talk 2

Prof. Hermann BRUNNER 布魯耐爾 海曼 教授
Dept of Mathematics, Hong Kong Baptist University
Department of Mathematics and Statistics Memorial University of Newfoundland,
St. John's, NL, Canada
http://www.math.hkbu.edu.hk/~hbrunner

Title: The numerical analysis of pantograph-type Volterra functional integral equations

Abstract:
The years 1971 and 1992/93 saw, respectively, the introduction of the pantograph equation, y’(t)= ay(t) + by (qt) (0 <q< 1), and the beginning of its in-depth numerical analysis. It is perhaps not as widely known that the very first studies of functional (integral) equations with proportional delay arguments date back to the work of Volterra (1897/1913), Picard (1907), Lalesco (1908/1911), and Andreoli (1913/1914). While most of the theory of such functional equations is now well understood, this is not true for their numerical analysis.
In this talk I will present a survey of some recent advances in the quantitative and qualitative numerical analysis of pantograph-type integral and integro-differential equations. The focus of the presentation will not be so much on the (super-) convergence and numerical stability results as on the underlying analytical and computational difficulties inherent in these \innocent-looking" delay equations. It will also become apparent that many related questions remain unanswered: in particular, it is not known under which conditions collocation methods on uniform meshes yield uniformly convergent solutions to the oldest of these functional integral equations, namely Volterra's first-kind equation of 1897. All this means that many challenging problems are waiting to be solved, especially in the numerical analysis of pantograph-type equations with nonlinear vanishing delays.

Talk 3

Prof. Tzon-Tzer LU 呂宗澤 教授
Department of Applied Mathematics, National Sun Yat-sen University
http://www.math.nsysu.edu.tw/faculty/ttlu.html

Title: Trefftz, Collocation and Other Boundary Methods -- A Comparison

Abstract:
We will survey the algorithms of the collocation method (CM), the Trefftz method (TM) and the collocation Trefftz method (CTM), and summarize the coupling techniques for the exterior and interior boundary conditions, which include the CTM (i.e., the indirect Trefftz method), the very original Trefftz method, the penalty plus hybrid Trefftz method, and the direct Trefftz method. Moreover, the error analysis is briefly addressed, and new numerical results are reported. Comparisons among TMs and other numerical methods are made. It is concluded that the CTM is the simplest algorithm, and provides the most accurate solution with the best numerical stability.

Talk 4

Prof. Chien-Sen HUANG 黃杰森 教授
Department of Applied Mathematics, National Sun Yat-sen University
http://www.math.nsysu.edu.tw/faculty/huangcs.html

Title: Fully conservative characteristic methods for transport problems

Abstract:
We consider the problem of simulating the macro-scale transport of inert (tracer) particles in a fluid. The system is generally modeled by a system of two equations, one for the bulk fluid velocity, and the other for the transport of the tracer. The latter equation is called an advection-diffusion equation. In the simplest but widely applicable case where the equation is linear, we may have contact discontinuities, but not shocks. In the absence of diffusion, tracer particles simply transport along the characteristic curves of the hyperbolic part of the transport equation, i.e., along streamlines. Characteristic methods exploit this fact numerically to provide accurate and numerically efficient approximation schemes. If single points are approximately transported, local mass balance errors result, degrading the accuracy of the method. If the mass in an entire region of space is transported, mass may be conserved locally. However, since the shape of the region distorts in time, it must be approximated in numerical implementation, and its volume may be incorrect. This results in inaccurate concentration densities, which has a surprisingly detrimental effect on the accuracy of the method. We present a simple modification of the method that conserves both mass and volume of the transported tracer fluid regions. The techniques are illustrated in several numerical examples involving flow in porous media (groundwater aquifers or petroleum reservoirs). A convergence theory is presented.

Talk 5

Dr. Leevan Ling 凌立雲 教授
Dept of Mathematics, Hong Kong Baptist University
http://www.math.hkbu.edu.hk/~lling

Title: Point Sources Identification Problem for Heat Equations

Abstract:
We considered a point source identification problem from observation data. We aim to identify the unknown source number and locations along with unknown strengths. We show that if the regularization parameter is chosen properly, the numerical procedures will converge to a sequence of moment equations involving our target unknowns. A reconstruction scheme is proposed on the basis of the developed theoretical results.

Talk 6

Prof. Kwok Po Ng 吳國寶 教授
Department of Mathematics, Hong Kong Baptist University
http://www.math.hkbu.edu.hk/~mng

Title: Inverse Filtering, Wavelet and TV Denoising for Image Restoration Problems

Abstract:
In this talk, I will review image restoration methods, and propose a new approach based on inverse filtering (deblurring), wavelet and TV denoising for image restoration methods. Numerical examples are given to illustrate the effectiveness of the proposed method.

Talk 7

Prof. Hong-Kun XU 徐洪坤 教授
Department of Applied Mathematics, National Sun Yat-sen University
http://www.math.nsysu.edu.tw/faculty/xuhk.html

Title: Iterative Methods for Solving Constrained Linear Inverse Problems

Abstract:
Due to inaccuracies of observations the linear model $Tf = h$ is ill-posed ; thus regularization is necessary. In this talk we shall report some recent results on iterative methods for solving the regularized minimization problem :

$$\text{minimize } \|g - Tf\|^2 + J(f),$$

where J is a continuous convex function defined on some closed covex subset C of a Hilbert space. A wide range of inverse problems arising in image reconstructions can be formulated in this way. The feature is that at each iteration, the involving operator is nonexpansive. As a result, iterative technieques of nonexpansive mappings apply, from which weak convergence of the iterative methods follow immediately. In some occasions strong convergence also holds.

Talk 8

Dr. Wai Chee Shiu 邵慰慈 教授
Department of Mathematics, Hong Kong Baptist University
http://www.math.hkbu.edu.hk/~wcshiu

Title: Edge-magic Labeling Matrices of the Composition of Paths with Null Graphs

Abstract:
Given two graphs *G* and *H*, the composition of *G* with *H* is the graph with vertex set $V(G)\times V(H)$ in which (u_1,v_1) is adjacent to (u_2,v_2) if and only if $u_1u_2 \in E(G)$ or $u_1 = u_2$ and $v_1v_2 \in E(H)$. In this talk, we shall construct some matrices with some special row sums, column sums or diagonal sums. By using these matrices we obtain an edge-magic labeling of the composition of P_n with N_n. Also we obtain an edge-magic labeling of the composition of P_m with N_{mk} for odd *mk* with $m \geq 3$ and $k \geq 1$.

Talk 9

Dr. Li-Da Tong 董立大 教授
Department of Applied Mathematics, National Sun Yat-sen University
http://www.math.nsysu.edu.tw/faculty/ldtong.html

Title: The orientable hull and geodetic numbers

Abstract:
For every pair of vertices u,v in an oriented graph, a u-v geodesic is a shortest directed path from u to v. For an oriented graph D, let $I_D[u,v]$ denoted the set of all vertices lying on a u-v geodesic or a v-u geodesic. And for $S\subseteq$ V(D, let I_D [S] denoted the union of all $I_D[u,v]$ for all u,v$\in$ S. If S is a convex set then $I_D[S]=S$. Let $[S]_D$ denoted the smallest convex set containing S. The geodetic number g(D) of an oriented graph D is the minimum cardinality of a set S with $I_D[S]=V(D)$. The hull number h(D) of a digraph D is the minimum cardinality of a set S with $[S]_D=V(D)$. For a connected graph G, let O(G) be the set of all orientations of G, define $g^-(G)= \min\{g(D):D\in O(G)\}$, $g^+(G)=\max\{g(D):D\in O(G)\}$, $h^-(G)= \min\{h(D):D\in O(G)\}$, and $h^+(G)= \max\{h(D):D\in O(G)\}$. By the definitions, $h^-(G)\leq g^-(G)$ and $h^+(G) \leq g^+(G)$. In the paper, we prove that $g^-(G)< h^+(G)$ for graph G of order at least 3 and show that, for any nonnegative integers a and b, there exists a connected graph G such that $g^-(G)-h^-(G)=a$ and $g^+(G)-h^+(G)=b$.

Talk 10

Dr. Daricks Chan 陳偉康 教授
Dept of Mathematics, Hong Kong Baptist University
http://www.math.hkbu.edu.hk/~dchan

Title: On the Bandwidth and Cyclic Bandwidth Problems of Graphs

Abstract:
The bandwidth minimization problem arises from a wide application area including sparse matrix computation, coding theory, data structure and the circuit layout of VLSI designs. In this talk, I will revisit the results on the bandwidth problem obtained in the past few decades including the bandwidth in some specific types of graphs, and the change of bandwidth of graphs under elementary operations. An analogous problem is the cyclic bandwidth problem of graphs. I will also introduce a necessary and sufficient condition to characterize graphs with equal bandwidth and cyclic bandwidth.

Talk 11

Dr. Zhi-shi Pan 潘志實 教授
Department of Applied Mathematics, National Sun Yat-sen University
E-mail: panzs@math.nsysu.edu.tw

Title: Construction of graphs with given circular flow number

Abstract:
Suppose $r \geq 2$ is a real number. A proper r-flow of a directed multi-graph $\vec{G} = (V, E)$ is a mapping $f : E \to \Re$ such that (i) for every edge $e \in E$, $1 \leq |f(e)| \leq r-1$; (ii) for every vertex $v \in V$, $\sum_{e \in E^+(v)} f(e) - \sum_{e \in E^-(v)} f(e) = 0$. The circular flow number of a graph G is the least r for which an orientation of G admits a proper r-flow. The well-known 5-flow conjecture is equivalent to the statement that every bridgeless graph has circular flow number at most 5. In this paper, we prove that for any rational number r between 2 and 5, there exists a graph G with circular flow number r.

Talk 12

Dr. Man Lai Tang 鄧文禮 教授
Dept of Mathematics, Hong Kong Baptist University
http://www.math.hkbu.edu.hk/~mltang

Title: Testing the non-unity of rate ratio under inverse sampling

Abstract:
Inverse sampling is considered to be a more appropriate sampling scheme than the usual binomial sampling scheme when subjects arrive sequentially, when the underlying response of interest is acute, and when maximum likelihood estimators of some epidemiologic indices are undefined. In this article, we study various statistics for testing non-unity rate ratios in case-control studies under inverse sampling. These include the Wald, unconditional score, likelihood ratio and conditional score statistics. Three methods (the asymptotic, conditional exact, and Mid-P methods) are adopted for P-value calculation. We evaluate the performance of different combinations of test statistics and P-value methods in terms of their empirical sizes and powers via Monte Carlo simulation. In general, asymptotic score and conditional score tests are preferable for their actual type I error rates, are well controlled around the pre-chosen nominal level, and their powers are comparatively the largest. The exact version of Wald test is recommended if one wants to control the actual type I error rate at or below the pre-chosen nominal level. If larger power is expected and fluctuation of sizes around the pre-chosen nominal level are allowed, then the Mid-P version of Wald test is a desirable alternative. We illustrate the methodologies with a real example from a heart disease study.

Talk 13

Prof. Mei-Hui Guo 郭美惠 教授
Department of Applied Mathematics, National Sun Yat-sen University
http://www.math.nsysu.edu.tw/faculty/guomh.html

Title: Monitoring Risk Factors of Heart Rate Variability for VICU Patients

Abstract:
In the literature, two important risk factors related to heart rate variability are discovered. The first risk factor is the ratio of low frequency (LF) to high frequency (HF) spectrum power, which is found to be useful in measuring sympathetic/parasympathetic balance. The second risk factor is related to low variability of heart rates. Continuous monitoring of these two risk factors has the potential to early detect physiological deterioration of patients. An recent finding also shows that heart rate data possess self-similar property, in the first part we compare different estimates of the self-similar parameter and establish the EWRMS and EWMV control charts monitoring low heart rate variability. In the second part, we propose a new LF/HF power ratio statistics and establish the control charts to monitor alterations of the LF/HF power ratio. The results are applied to monitor the ratio statistics and heart rate variability for patients after operation in vascular intensive care units(VICU).