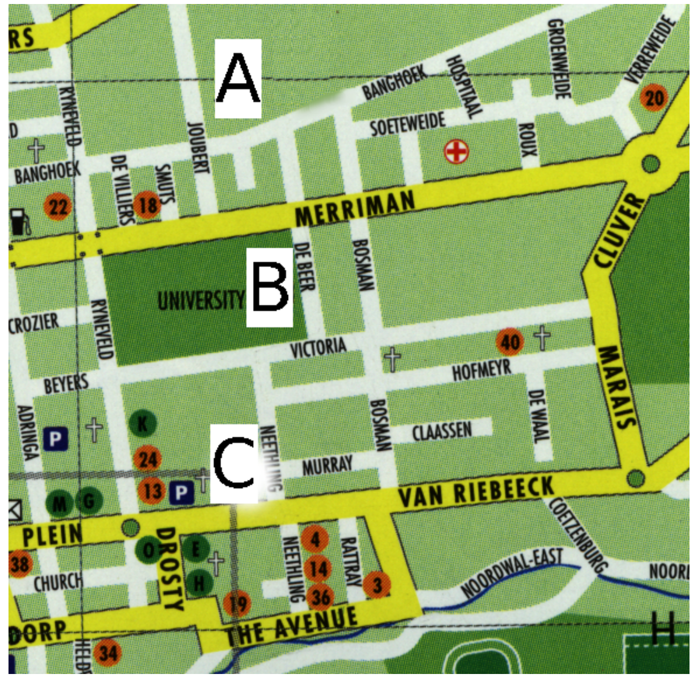
Registration, lectures and tea breaks

Registration is on Monday 2 April 2007 from 08:00 to 08:50 in the foyer of the general engineering building (on the corner of Banghoek and Joubert roads, marked A on the map below). All tea breaks will also be held in the foyer of the general engineering building.



Lunches

Lunch will be at Die Bloukamer, in the Neelsie student center (marked B on the map) and are included for all conference participants.

Reception

Drinks and light snacks will be served between 08h00 and 20h00 at Katjiepiering Restaurant in the Stellenbosch botanical gardens (marked C on the map).

Conference Dinner

The conference dinner is on Tuesday, 03 April 2007 at Restaurant Barrique at Vredenheim Estate. We will leave from the parking in front of the general engineering building at 18:00 to arrive at the restaurant at 18:30. Those who need a lift and those who can offer a lift must please meet in front of the general engineering building. Note that the conference dinner is not included in the student registration fee.

Email

Details of email and internet facilities will be announced.

Wednesday 26 March

FIRST–ORDER SYSTEM LL* (FOSLL*) FOR MAXWELL'S EQUATIONS IN 3D WITH EDGE SINGULARITIES.

Prof. Tom Manteuffel (University of Colorado)

Many important applications involve the solution of the eddy current approximation to Maxwell's equations. For example, mathematical models of magnetically confined plasma in tokomak geometry lead to magnetohydrodynamic equations (MHD) in which Maxwell's equations play a major role. Sandia's Z-pinch reactor provides another important application. In this talk we focus on a first-order system least- squares (FOSLS) formulation of the eddy current approximation to Maxwell's equations. The L^2–norm version of FOSLS yields a least-squares functional whose bilinear part is H^1–elliptic. This means that the minimization process amounts to solving a loosely coupled system of scalar elliptic equations. An unfortunate limitation of the L^2–norm FOSLS approach is that this product H^1 equivalence generally requires sufficient smoothness of the original problem. Inverse–norm FOSLS overcomes this limitation, but at a substantial loss of real efficiency. The FOSLL* approach described in this talk is a promising alternative that is based on recasting the original problem as a minimization principle involving the adjoint equations. This talk provides a theoretical foundation for the FOSLL* methodology and application to the eddy current form of Maxwell's equations. It is shown that singularities due to discontinuous coefficients are easily treated. However, singularities due to reentrant edges require a further modification. A partially weighted norm is used only on the slack equations. The solution retains optimal order accuracy and the resulting linear systems are easily solved by multigrid methods. Comparison is made to the curl/curl formulation, which requires Nedelec finite elements, and the weighted regularization approach, which requires a finite element space with a C^1 subspace. The FOSLL* approach uses standard H^1 conforming finite element spaces, is shown to have equal or better accuracy, obtained at a smaller cost. Numerical examples are presented that support the theory.

SYMBOLIC COMPUTATION OF CONSERVATION LAWS OF NONLINEAR PDES IN (N+1)-DIMENSIONS

Prof. Willy Hereman (Colorado School of Mines)

A direct method will be presented for the symbolic computation of conservation laws of nonlinear PDEs in (N+1)-dimensions. The conserved densities are constructed as linear combinations of scaling homogeneous terms with undetermined coefficients. The variational derivative is used to compute the undetermined coefficients. The homotopy operator is used to find the fluxes. The method has been implemented in Mathematica. Using the (2+1)-dimensional shallow-water wave equations as an example, a computer package will be demonstrated that symbolically computes conservation laws of nonlinear PDEs. The software is being used to compute conservation laws of fluid flow (based on the Navier and Kadomtsev-Petviashvili equations) and transonic gas flow.

THE STABILITY OF TIME-PERIODIC BOUNDARY LAYERS

Prof. Andrew Bassom (University of Western Australia)

Oscillatory flows occur naturally in many applications ranging across many disciplines from engineering to physiology. Transition to turbulence in such flows is a topic of practical interest and the natural setting for the analysis of the linear stability of oscillatory flows lies with Floquet theory. Unfortunately, however, the application of this approach has proved to be less straightforward than might be hoped. In particular, theoretical predictions of stability boundaries do not correlate at all well with experimental measurements. In this talk I will discuss how recent work has furthered our understanding of the stability of a class of time- periodic fluid motions and how the subject might be developed in future.

CLASSICAL AND GENERALIZED SHOCK-INDUCED INTERFACIAL INSTABILITIES

Prof. Qiang Zhang (City University of Hong Kong)

We study the classical fingering instability induced by a shock that propagates across a perturbed interface between fluids of different densities. We derive an analytical nonlinear theory which provides predictions for the growth rate and the size of the fingers. The theoretical predictions are in remarkably good agreement with the results from full-scale numerical simulations. We also study the generalization of this instability in granular systems. We show that if the collisions between the particles conserve energy, the behavior of generalized fingering instability in granular materials is very similar to that of classical instability in fluids. However, our study also showed a very surprising result: the energy loss during particle collisions, even when very small, causes growth of the fingers in granular systems to be dramatically different from that in fluids. The fingers formed by the light particles grow faster and become longer and narrower than the fingers formed by the heavy particles. This is completely opposite to the behavior of classical fingers in fluids, In addition, the finger composed of light particles collapse into an extremely compact, tortuous filament, and diffusive mixing between particle types at the particle scale is heavily suppressed. This work is supported by Research Grant Committee of HKSAR grant No. CityU 103504.

AN EFFICIENT COMPUTATIONAL APPROACH TO SOLVE A SYSTEM OF COUPLED SINGULARLY PERTURBED DIFFERENTIAL EQUATIONS

Prof. Kailash C. Patidar (University of the Western Cape)

We consider a system of coupled singularly perturbed ordinary differential equations. An efficient numerical method is designed and analyzed for this system. Competitive numerical results (confirming the theoretical estimates) are obtained and will be presented at the conference. Extensions of the proposed approach for the system of two parabolic singularly perturbed will also be explored.

ABSOLUTE-CONVECTIVE INSTABILITY OF A BUOYANT BOUNDARY LAYER FLOW.

Dr Eunice Mureithi (University of Pretoria)

The question of the absolute/convective instability of a mixed forced-free convection boundary layer is considered. The base flow considered is the self-similar flow with free-stream velocity $u_e \sim x^n$. Such a boundary layer present the unusual behaviour of generating a region of velocity overshoot, in which the streamwise velocity within the boundary layer exceeds the free-stream speed. The linear stability analysis results indicate that flow overshoot sets at much lower values of the buoyancy parameter G_0 than the absolute instability. A critical value for the buoyancy parameter, $G_0 \approx 3.6896$, has been determined below which the flow is convectively unstable and above which the flow is absolutely unstable. Absolute instability increases with increase in the buoyancy parameter. The results also indicate as $\alpha_r \to 0$ the spatial growth rate for the "long wave" abruptly increases/decreases depending on whether $G_0 > 3.6893$ or $G_0 < 3.6893$.

CONSERVATION LAWS AND CONSERVED QUANTITIES FOR LAMINAR JETS

Prof. David Mason (University of the Witwatersrand)

Conservation laws for Prandtl's boundary layer equarions for two- dimensional and radial jets are investigated.The multiplier approach is used to derive a basis of conservation laws for the system of two partial differential equations for the fluid velocity components and the third order partial differential for thr stream function. Using the conservation laws an alternative derivation is given for the conserved quantities for the liquid jet, free jet and wall jet.

NUMERICAL SOLUTION OF A RIMMING FLOW PROBLEM USING A MOVING MESH METHOD

Dr Stephen Sikwila (National University of Lesotho)

We consider the motion of a thin film of a viscous liquid placed in a cylindrical tube of radius R whose axis is horizontal and which is rotating with a constant angular velocity ω. During the rotation, the viscous fluid is dragged up the inner wall of a horizontal cylinder. For very high rotation rates, the fluid covers the inside part of the cylinder uniformly. But for small rotation rates an interior layer forms. This is because the rotation rate is too slow to support the liquid mass. Because of the existence of an interior layer, special numerical techniques have to be used to numerically compute the time evolution of the film to a steady state efficiently and accurately, hence the moving mesh method will be used. Within this method a mesh equation, is employed to move the mesh points and keeps them concentrated in areas of large solution variations, thereby giving us more accurate results than a uniform mesh for the same number of mesh points. The other advantage that this method has is that it enables one to track the evolution of the interior layer up to the steady state position.

SAVING FACE IN 3D

Willie Brink (Sheffield Hallam University)

Automatic face recognition is one of the most important applications of image analysis and computer vision. It holds benefits for a multitude of domains in law enforcement, surveillance, information security, access control and human-computer interaction. Significant advances have been made in image-based recognition systems, but challenges remain. Difficulties include unforeseen variations in light intensity, illumination, scale, head pose and facial expression, all of which can cause different images of the same individual to appear significantly different. Recent focus has shifted to 3D face recognition systems, that consider the shape of faces rather than colour in 2D images, to alleviate the problems mentioned. A major obstacle however is that these systems require a special device for capturing depth information. Although extensive research continues in the recognition of 3D models there is a noticeable lack in methods to acquire such models robustly, accurately, quickly and inexpensively. We address these issues and in the talk I shall discuss a DIY method for generating 3D face models. It is based on the well-known concept of structured light scanning.

ON EXTRAPOLATION TECHNIQUES FOR THE SINGULAR PERTURBATION PROBLEMS

Justin B. Munyakazi (University of the Western Cape)

We discuss some extrapolation methods for a class of singularly perturbed two-point boundary value problems. Such convergence acceleration techniques, e.g. Richardson extrapolation, are popularly used in the literature. However, these techniques do not perform equally well on all type of methods. In this talk, we will address some of the issues associated with a number of methods and explore the possible remedies. Finally, the performance of such techniques is analyzed and will be demonstrated numerically.

THE FAST MULTIPOLE METHOD WITH 1D, 2D AND 3D PERIODIC BOUNDARY CONDITIONS.

Ivo Kabadshow (Research Centre Juelich)

In several scientific applications such as molecular dynamics, astrophysics or plasma physics the evaluation of a pairwise potential is required. Very often this is the most time consuming step in a calculation. The direct method to evaluate these potentials scales quadratically with the number of particles which places a severe restraint on the size of systems which can be treated. One of the most efficient methods to achieve linear scaling is Greengard's Fast Multipole Method (FMM). The concept of the FMM is to group together remote charges such that a collection of distant charges can be treated as one single charge. Local charges are expanded in multipole expansions. The FMM is a computational scheme to manipulate these expansions to achieve linear scaling. In this talk we present our enhanced FMM implementation to treat both open systems and systems with periodic boundaries. Unlike other implementations our approach is not based on an Ewald summation scheme. Based on a renormalization approach all multipole interactions from the simulation cell with the periodic image-cells can be precomputed with high precision. The algorithm can be used for cubic cells with periodic boundary conditions in one, two or three dimensions. Additionally, we show error-bounds and timings as well as a comparison to Ewald summation schemes.

SYMMETRIES OF A LAGRANGIAN AND CONFORMAL KILLING VECTORS FOR THE MINKOWSKI SPACETIME

Dr Ibrar Hussain (DECMA, Wits University, Johannesburg)

Using the Lie symmetry methods for differential equations we have investigated the symmetries of a Lagrangian for the Minkowski metric. It is shown that the symmetry algebra is 17 dimensional which properly contains the conformal Killing vectors of the Minkowski metric.

TOWARDS A MATHEMATICAL ANALYSIS FOR DRIFT-FLUX MULTIPHASE FLOW MODEL IN NETWORKS

Jean-Medard Tchoukouegno Ngnotchouye (University of KwaZulu-Natal)

Dynamics of multiphase flows through networks are considered. The dynamics of flow through the connected arcs is governed by an isothermal no-slip drift-flux model. Such problems arise in the context of multicomponent flows or in gas transport in pipe networks in which a phase change takes place due to geometrical or physical forces. Coupling conditions for the vertices (joints) in a network have been proposed. We present conditions at and introduce a mathematical representation of the vertex flow for the no-slip drift- flux case of multiphase flows. Mathematical analysis of coupling conditions at the vertices as well as numerical simulations and comparative studies with theoretical predictions are undertaken.

Thursday 27 March

ESSENTIALLY OPTIMAL EXPLICIT RUNGE-KUTTA METHODS WITH APPLICATION TO HYPERBOLIC-PARABOLIC EQUATIONS

Prof. Rolf Jeltsch (ETH Zurich)

Essentially optimal explicit Runge-Kutta methods consider more stages in order to include a particular spectrum in their stability domain and thus reduce step restrictions. This idea, so far used mostly for real line spectra, is generalized to more general spectra in form of a thin region. In this regions the eigenvalues may extend away from the real axis into the imaginary plane. We give a direct characterization of essentially optimal stability polynomials containing a maximal thin region and calculate these polynomials for various cases. Semi- discretizations of hyperbolic-parabolic equations are a relevant application which exhibit a thin region spectrum. As a model, linear scalar advection-diffusion is inverstigated. The second order stabilized Runge-Kutta methods derived from the stability polynomials are applied to advection-diffusion and compressible, viscous fluid dynamics in numerical experiments. Due to the stabilization the time step can be controlled solely from the hyperbolic CFL condition even in the presence of viscous fluxes. (Manuel Torrilhon and Rolf Jeltsch Seminar for Applied Mathematics, ETH, CH-8092 Zurich, Switzerland)

SOME PROBLEMS IN THE NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS

Prof. Jeffrey Cash (Imperial College)

Codes for solving ordinary differential equations and parabolic partial differential equations have improved greatly in terms of speed and reliability over the past few years. However there are still some classes of problems that codes perform very poorly on. In this lecture we consider some areas where advances in the theory are needed. In particular we mention the need for algorithms to determine the index of a given differential algebraic equation, to have tolerance proportionality in stiff equations, the need to investigate conditioning when solving two-point boundary values problems using global methods and algorithms for space discretization in the numerical method of lines.

TBA

Dirk Laurie (Stellenbosch University)

TBW

IMPROVED CONTOUR INTEGRAL METHODS FOR PARABOLIC PDES

Andre Weideman (Stellenbosch University)

One way of computing the matrix exponential that arises in semi- discrete parabolic PDEs is via the Dunford-Cauchy integral formula. The integral is approximated by the trapezoidal rule on a Hankel contour defined by a suitable change of variables. In a recent paper by the speaker and LN Trefethen [Math. Comp., Vol. 76, pp. 1341–1356 (2007)] two widely used contours were analyzed. Estimates for the optimal parameters that define these contours were proposed. In this talk, this analysis is extended in two directions. First, the effect of roundoff error is now included in the analysis. Second, we extend the results to the case of a model convection-diffusion equation, where a large convective term causes the matrix to be highly non- normal.

GAUSS-TYPE NESTED IMPLICIT RUNGE-KUTTA FORMULAS OF ORDER 4

Prof. Gennady Kulikov (University of Witwatersrand, Johannesburg)

This paper deals with a special family of implicit Runge-Kutta formulas of order 4. These methods are of Gauss type; i.e., they are based on the Gauss quadrature formula of orders 4. However, the methods under discussion have only explicit internal stages that lead to cheap practical implementation. Some of the stage values calculated in a step of the numerical integration are of sufficiently high accuracy that allows for dense output of the same order as the Runge-Kutta formula used. On the other hand, the designed methods are A-stable, stiffly accurate and symmetric. Moreover, they are conjugate to a symplectic method up to order 6 at least. All of these make the new methods attractive for solving nonstiff and stiff ordinary differential equations, including Hamiltonian and reversible problems. For adaptivity, different strategies of error estimation are discussed and examined numerically.

COUETTE FLOW OF A THIRD-GRADE FLUID WITH ROTATING FRAME AND PARTIAL SLIP

Prof. Shirley Abelman (University of the Witwatersrand, Johannesburg)

The steady rotating flow of an incompressible third-grade fluid due to a suddenly moved plate when there is partial slip of the fluid on the plate is analysed. The fluid filling the porous space between the two infinite plates is electrically conducting. The flow modeling in a porous space is developed by employing a modified Darcy's law. A numerical solution of the governing problem consisting of a non-linear ordinary differential equation and non-linear boundary conditions is obtained and discussed. Several limiting cases of the arising problem can be obtained by choosing suitable parameters.

DOING NON LINEAR NUMERICAL ANALYSIS WITH RON MITCHELL

Prof. Schalk Schoombie (University of the Free State)

In 1987 I visited Ron Mitchell for six months. Ron was very excited at the time about the use of dynamical systems methods in the analysis of numerical schemes, and so we worked on a finite difference scheme of a Fisher equation with non linear diffusion. In this talk I reminisce about the way we worked, and describe some of the results we obtained.

SOLUTION OF HYPERBOLIC NON-LINEAR EQUATIONS BY THE SPLITTING-UP METHOD

Prof. Mamadou Sango (University of Pretoria)

We establish the existence of a weak probabilistic solution for a class of damped stochastic nonlinear hyperbolic equations. The approach is based on an adequate blending of the splitting-up method with deep probabilistic compactness results.

NUMERICAL METHODS FOR THE EXTENSION OF VISCOUS THREADS

Dr Jonathan Wylie (City Univ of Hong Kong)

In this talk an accurate numerical method for the extension of viscous threads will be described. Using this method, the role played by viscous heating in extensional flows of viscous threads with temperature-dependent viscosity will be carefully examined. We show that there exists an interesting interplay between the effects of viscous heating, which accelerates thinning, and inertia, which prevents pinch-off. Our results show that viscous heating can have a profound effect on the extension process.

HYPERBOLIC PARTIAL DIFFERENTIAL EQUATIONS WITH BOUNDARY DISSIPATION

Prof. Nic Van Rensburg (University of Pretoria)

We consider hyperbolic partial differential equations where dissipative terms occur in the boundary conditions rather than the differential equation. Problems of this type lead to serious questions of a purely mathematical nature: Existence of solutions, methods to calculate or approximate solutions and eigenvalue problems for non-selfadjoint operators in Hilbert space. The wave equation with boundary dissipation is the simplest example of problems of this type. We use the wave equation to introduce the subject and the first part of this talk is mostly at an elementary level. Surprisingly, even this problem leads to serious difficulties and we give examples of recent publications. In the second part of the talk we discuss the general problem and the resulting quadratic eigenvalue problem which is equivalent to an eigenvalue problem for a nonselfadjoint operator. Again examples of recent publications are given. Note that problems of this type model the suppression of vibration in an elastic body and has important applications in engineering.

A TIMOSHENKO BEAM WITH BOUNDARY DAMPING

Dr Anneke Labuschagne (University of Pretoria)

Unwanted vibrations often occur in structures consisting of a system of elastic bodies. It often happens that natural damping is not sufficient to suppress the vibrations and this may lead to damage of the structure. Engineers create artificial damping to suppress vibrations when necessary. Devices are placed at the endpoints or joints. A thorough discussion of such a problem is given by Newland in a book and a series of articles. It concerns vertical slender structures like masts or chimneys. These design problems represent serious challenges of a mathematical nature. For a start one may consider only linear boundary damping for single elastic body. Numerous investigations were carried out and publications appeared right up to 2007. In some of these publications important mathematical problems are considered. The Timoshenko model for a pinned-pinned beam in dimensionless form is given by

$$\partial_t^2 w = \partial_x^2 w - \partial_x \phi, \tag{2.1}$$

$$\frac{1}{\alpha}\,\partial_t^2 \phi = \partial_x w - \phi + \frac{1}{\beta}\,\partial_x^2 \phi, \tag{2.2}$$

$$\partial_x \phi(0,t) = \partial_x \phi(1,t) = 0, \tag{2.3}$$

$$w(0,t) = w(1,t) = 0.$$

When linear damping is introduced at the the boundary point $x = 1$, we have $\partial_x \phi(1,t) = -\mu \partial_t \phi(1,t)$. A numerical investigation shows a continuous change from the pinned-pinned case to the pinned-clamped case if the damping constant k increases. A practical problem is to determine an optimal value for the damping parameter k. The numerical results show the difficulties involved.

SYNCHRONIZATION OF SEMICONDUCTOR LASERS WITH COEXISTING ATTRACTORS

Prof. Alexander Pisarchik (Centro de Investigaciones en Optica)

Synchronization between two semiconductor lasers with external cavities operating at a monostable chaotic regime is well studied. Here we study numerically the case when two semiconductor lasers with external cavities coupled in a master-slave configuration exhibit coexistence of two different attractors: chaotic attractors, periodic orbits, fix point and chaos, and fix point and period orbit. We demonstrate very rich dynamics of the coupled system depending of the multistability operating point and the coupling coefficient between the master and slave lasers. One can observe Hopf bifurcations, high periodic orbits, quasiperiodicity, and finally when the coupling is large enough, complete synchronization arises. We investigate the synchronization problem of the multistable systems in details and discuss possible mechanisms responsible for different synchronization regimes depending on the coupling strength.

Friday 28 March

NEAR BEST RATIONAL APPROXIMATION AND SPECTRAL METHODS

Dr Joris Van Deun (Dept. Math. & Computer Science, University of Antwerp)

Polynomial interpolation in Chebyshev points is near best in the sense that the interpolant is close to the true minimax polynomial and gives a very uniform interpolation error. Spectral methods for solving ODEs and boundary value problems implicitly rely on this property. For problems with one or more interior boundary layers, however, polynomials do not perform well. This talk presents a rational generalisation of Chebyshev polynomials which can be used for such problems. A comparison is made between the polynomial and rational case and some examples illustrate the applicability in spectral methods.

EXPLORING THE SILICON CELL

Prof. Jan-Hendrik Hofmeyr (Stellenbosch University)

A major aim of systems biology is the creation of what has come to be known as the "Silicon Cell", a system of differential equations $ds/dt = Nv$ that describes the dynamic behaviour of the huge network of coupled, enzyme-catalysed reactions that make up the living cell. How the metabolite concentrations in vector s change with time depends on the topology of the network, captured in the stoichiometry matrix N, and on the rate vector v. Much effort has gone into analysing the structural information in N and has led to a number of useful methods such as flux-balance analysis and elementary mode analysis. I shall, however, concentrate on the kinetic aspects of network behaviour that depend on the enzyme rate equations that determine v. Traditional enzyme kinetics was designed to study mechanism and is in many respects unsuitable for the task; we had to create what is in effect a new enzyme kinetics for systems biology. I shall further discuss two aspects: 1. How metabolic control analysis and a generalised supply-demand analysis allow us to understand the regulatory design of metabolism, i.e., to what degree the properties of the components of the system are tuned to each other to ensure a functional whole. 2. How the mathematical expression of systemic properties (control coefficients) in terms of local step properties (elasticity coefficients) enable us to dissect and quantify the response of the metabolic steady state to a perturbation into chains of local effects (control patterns) that propagate through the system. These approaches allow us to interrogate silicon cell models in ways that are virtually impossible to do experimentally, and so provide one answer to the question "so what are you going to do with your silicon cell once you have built it"?

PROJECTION METHODS AND INCREMENTAL SUBGRADIENTS: RESULTS AND

Prof. Alvaro De Pierro (State University of Campinas)

Methods based on orthogonal projections have been very popular for solving convex feasibility problems arising in image processing and reconstruction as well as in many other areas of application. In this talk we describe the evolution of this kind of methods, the conjectures about their behaviour, from sequential to parallel versions, together with the possibility of considering projections that are not orthogonal. As a natural consequence of this evolution we present a new class of incremental subgradient methods for solving general optimization problems, briefly describing their main convergence properties. We also present numerical simulations showing the application of incremental methods to optimization problems that arise in image reconstruction from incomplete data, using recent ideas coming from new sampling theories.

EFFECTIVE ESTIMATION AND LIKELIHOOD EVALUATION IN HIV REPEATED SURVEYS USING KALMAN FILTER APPROACH

Dr Maria Kulikova (University of Witwatersrand, Johannesburg)

A number of statistical series are estimated on the basis of regularly repeated surveys. A variety of the statistical applications includes economic forecasting, biological monitoring, quality control and many others. The most common approach is to publish parameter estimates at regular intervals, say each year, pooling surveys collected throughout the year but ignoring previous years. Another approach is to use the information collected throughout the year to obtain more accurate estimates by taking into account the time-series nature of the repeated surveys. In the past few years the Kalman filter has been intensively used in repeated surveys. However, the numerical properties of the algorithm are usually not taken into account. In practice, the use of the conventional Kalman filter, which is known to be numerically unstable, leads to inaccurate estimates and forecasting. In this paper we summarize the most promising implementation methods for Kalman filtering formulas and discuss the special role of information-type implementations in repeated surveys. We also present new efficient algorithms for estimation and likelihood evaluation in HIV repeated surveys based upon the square-root information filter with scalar updates. They are more reliable in practice and less time consuming compared to the conventional Kalman filter approach. The theoretical results are given together with

ANALYSIS OF SOFT COMPUTING TECHNIQUE TO MINIMIZ THE LOCAL MINIMA PROBLEM IN PATTERN RECOGNITION FOR HAND WRITTEN ENGLISH ALPHABETS.

Dr Manu Pratap Singh (Dr. B.R. Ambedkar University, Agra)

The back-propagation algorithm suffers with the local minima error surface for a large set of problems. A local minimum is defined as a point such that all points in a neighborhood have an error value greater than or equal to the error value in that point. These regions of local minima occur for combinations of the weights from the inputs to the hidden nodes such that one or both hidden nodes are saturated for at least two patterns. However, boundary points of these regions of local minima are saddle points. This paper describes the soft computing techniques for the performance evaluation of Back- propagation algorithm to recognize the hand written English alphabets. Two different architectures of neural network have been taken with five trials of each network. It has been analyzed that the conventional back-propagation algorithm suffers with the problem of not convergence the weights. The results of the experiments and result shows that the conventional back-propagation algorithm does not suites to solve the challenging problem most reliably and efficiently.

ANALYSIS OF K-MEANS CLUSTERING ALGORITHM WITH PATTERN CLASSIFICATION TECHNIQUES OF NEURAL NETWORKS

Dr Manu Pratap Singh (Dr. B.R. Ambedkar University, Agra)

Data classification and clustering is one of the mean important data mining techniques. Its objective is to construct a prediction model using a training data set for predicting class of unlabeled objects. With the emergence of very large data and complex data types and limitation of relational database management system to support those data, it has been recognized that those techniques play important role in complex data management for information retrieval. Data Mining is a technology used in different disciplines to search for significant relationships among variables in large data sets. In this paper, we focus on the application of data mining in database system and analysis for k-means algorithm performance with pattern classification techniques of neural networks. Keywords : Data Mining, Classification and cluster analysis, K-Means Algorithm, Backpropagation Algorithm

INTERPOLATORY REFINEMENT PAIRS WITH PROPERTIES OF SYMMETRY AND POLYNOMIAL FILLING

Mpfareleni Rejoyce Gavhi (University of Stellenbosch)

Subdivision schemes are important and efficient tools for generating smooth curves and surfaces used in computer aided geometric design (CAGD) and in wavelet decomposition. Out of many subdivision schemes, we consider in this talk particularly interpolatory subdivision schemes (ISS), which have the property that the limit curve interpolates the original control points. We first present the issues of interpolation, symmetry and polynomial filling with respect to a subdivision scheme, eventually leading to a definition of a class of symmetric interpolatory subdivision schemes with the polynomial filling property up to a given odd degree in which all of the above desired properties are combined. Finally, we derive an explicit characterization formula for the above class. For the case of one degree of freedom in the form of a shape parameter t, we establish an interval for t in which refinable function existence, and therefore also subdivision convergence, are guaranteed.

NUMERICAL SOLUTION OF PT-SYMMETRIC SCHRÖDINGER EQUATION

Gert Wessels (University of Stellenbosch)

Schrödinger's equation with the PT-symmetric potential $V(x) = -(ix)^N$ is solved numerically using the Runge-Kutta based shooting method, the spectral collocation method with weighted Hermite polynomial interpolants and the Riccati-Padé method. A comparison will be made of the accuracy and run time of these methods.

INVERSION OF LAPLACE TRANSFORM FOR SOLVING PARTIAL DIFFERENTIAL EQUATIONS

Edgard Ngounda (Stellenbosch university)

We consider the numerical inversion of the Laplace Transform as a method for integrating parabolic partial differential equations. In this talks we compare the efficiency of this method with more traditional integrators like Crank-Nicolson method and MATLAB's ODE solver ode15s. As a model problem we use the standard heat equation.

FINITE DIFFERENCE METHODS WITH NON-UNIFORM GRIDS FOR OPTION PRICING IN FINANCE.

Fernando Nieuwveldt (University of Stellenbosch)

In option pricing in finance the final condition is not always differentiable. In this talk non-uniform grid discretization will be applied for better accuracy. The method works with a coordinate transformation on the PDE and applying a uniform mesh over the transformed PDE. Numerical results will be given.

THE KORTEWEG-DE VRIES HIERARCHY: SOME ANALYTICAL AND NUMERICAL SOLUTIONS

Edson Pindza (University of Stellenbosch)

Analytical and numerical solutions of the third and fifth order Korteweg-de Vries equations will be discussed. In particular, the analytical solutions obtained by Fan's method, Painleve expansion, as well as the Simplified Hirota method will be presented and compared. Numerical solutions using spectral differentiation for the spatial part and Runge-Kutta time differencing are obtained and will be presented.

Attendees

	Name	Surname	Affiliation	E-mail
0	Stefan Johann	Van der Walt	University of Stellenbosch	stefan@mentat.za.net
1	Neil	Muller	University of Stellenbosch	neil@dip.sun.ac.za
2	Karin	Hunter	University of Stellenbosch	karin@sun.ac.za
3	Andre	Weideman	Stellenbosch University	weideman@dip.sun.ac.za
4	Jonathan	Wylie	City Univ of Hong Kong	mawylie@cityu.edu.hk
5	Dirk	Laurie	Stellenbosch University	dpl@sun.ac.za
6	McElory	Hoffmann	University of Stellenbosch	mr@mcelory.co.za
7	Gennady	Kulikov	University of Witwatersrand, Johannesburg	Gennady.Kulikov@wits.ac.za
8	Maria	Kulikova	University of Witwatersrand, Johannesburg	Maria.Kulikova@wits.ac.za
9	Ibrar	Hussain	DECMA, Wits University, Johannesburg	ibrar_msw@yahoo.com
10	Sajid	Ali	Center For Advanced Mathematics and Physics, National University of Sciences and Technology	sajid_ali@mail.com
11	Ivo	Kabadshow	Research Centre Juelich	i.kabadshow@fz-juelich.de
12	Rolf	Jeltsch	ETH Zurich	jeltsch@math.ethz.ch
13	Justin B.	Munyakazi	University of the Western Cape	jmunyakazi@uwc.ac.za
14	Amir Hossein	Tabatabaei	Sadra University	tabatabaei.amirhossein@gmail
15	Stephen	Sikwila	National University of Lesotho	drstsikwila@yahoo.co.uk
16	jeanne-marie	Roux	university of stellenbosch	14092662@sun.ac.za
17	Alvaro	De Pierro	State University of Campinas	alvaro@ime.unicamp.br
18	Eunice	Mureithi	University of Pretoria	eunice.mureithi@up.ac.za
19	David	Mason	University of the Witwatersrand	David.Mason@wits.ac.za
20	masande patrick	Magadi	university of fort hare	mgadimp@yahoo.com
21	Babatunde	Ogundare	University of Fort Hare	bogundare@ufh.ac.za
22	Tom	Manteuffel	University of Colorado	tmanteuf@colorado.edu
23	Kailash C.	Patidar	University of the Western Cape	kpatidar@uwc.ac.za
24	Willy	Hereman	Colorado School of Mines	whereman@mines.edu
26	Qiang	Zhang	City University of Hong Kong	mazq@cityu.edu.hk
27	Jeffrey	Cash	Imperial College	j.cash@ic.ac.uk
28	Andrew	Bassom	University of Western Australia	bassom@maths.uwa.edu.au
29	Anneke	Labuschagne	University of Pretoria	anneke.labuschagne@up.ac.za
30	Nic	Van Rensburg	University of Pretoria	nvrens@scientia.up.ac.za
31	Manu Pratap	Singh	Dr. B.R. Ambedkar University, Agra	manu_p_singh@hotmail.com
32	Edgard	Ngounda	Stellenbosch university	14496933@sun.ac.za
33	Babatunde	Ogundare	University of Fort Hare	ogundareb@yahoo.com
34	Shirley	Abelman	University of the Witwatersrand, Johannesburg	Shirley.Abelman@wits.ac.za
35	Schalk	Schoombie	University of the Free State	schoomsw.sci@ufs.ac.za

36	Willie	Brink	Sheffield Hallam University	willie.brink@gmail.com
37	Alexander	Pisarchik	Centro de Investigaciones en Optica	apisarch@cio.mx
38	Gert	Wessels	University of Stellenbosch	wessels@sun.ac.za
39	Jean-Medard	Tchoukouegno Ng-notchouye	University of KwaZulu-Natal	207521833@ukzn.ac.za
40	Jan-Hendrik	Hofmeyr	Stellenbosch University	jhsh@sun.ac.za
41	Mpfareleni Rejoyce	Gavhi	University of Stellenbosch	rejoya@sun.ac.za
42	Fernando	Nieuwveldt	University of Stellenbosch	13930761@sun.ac.za
43	Rinske	Van der Bijl	University of Stellenbosch	rinske@sun.ac.za
44	Joris	Van Deun	Dept. Math. & Computer Science, University of Antwerp	joris.vandeun@ua.ac.be
45	Mamadou	Sango	University of Pretoria	sango177@yahoo.com
46	John	Dalton	Stellenbosch University	13903276@sun.ac.za
47	Helge	Reikeras	University of Stellenbosch	14524104@sun.ac.za
48	Barry-Michael	Van Wyk	University of Stellenbosch	bmvanwyk@gmail.com
49	Cheslin	Hickley	Stellenbosch University	14646579@sun.ac.za
50	Jolani	De la Porte	University of Stellenbosch	14307804@sun.ac.za
51	Sampson Akinleye Olundare	Panneah-Ajiteru	University of Ibadan	universityofibadan40@
52	Veronica Sitsofe	Ahiati	University of Stellenbosch	veronsitso@sun.ac.za
53	Edson	Pindza	University of Stellenbosch	14494663@sun.ac.za
54	Ben	Herbst	University of Stellenbosch	herbst@sun.ac.za
55	Barton	Profitt	Applied Mathematics, Stellenbosch	bprofitt@gmail.com
56	Jan Abraham	Botha	Stellenbosch University	14144484@sun.ac.za
57	Johan	De Villiers	Stellenbosch University	jmdv@sun.ac.za
58	gaelle	Andriamaro	mathematics department	gaelle@sun.ac.za
59	fabien	Rabarison	mathematics department	fabi@sun.ac.za

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