Nov. 26 (Sat.)		Nov. 27 (Sun.)	
9:00 -- 9:20	Registration	**Chairman:** Hitoshi Imai	
9:20 -- 9:30	Opening Address (I -Liang Chern, Yuusuke Iso)	9:00 -- 9:40	Prof. Hong-Ki Hong
Chairman: Jeng-Tzong Chen		9:45 -- 10:10	Mr. Suguru Maekawa
9:30 -- 10:10	Prof. Toshiro Matumoto	10:10 -- 10:35	Prof. Chin-Tien Wu
10:15 -- 10:40	Prof. Wei-Cheng Wang	10:35 -- 10:55	Break
10:40 -- 11:00	Break	**Chairman:** Hiroshi Fujiwara	
Chairman: Takashi Sakajo		10:55 -- 11:20	Prof. Weichung Wang
11:00 -- 11:25	Prof. Isakari	11:20 -- 11:45	Prof. Pengwen Chen
11:25 -- 11:50	Prof. Wei-Ming Lee	11:45 -- 12:10	Prof. Hitoshi Imai
11:50 -- 12:15	Mr. Ryota Misawa	12:10 -- 14:00	Lunch
12:15-- 14:00	Lunch	**Chairman:** Weichung Wang	
Chairman: Ming-Chih Lai		14:00 -- 14:40	Prof. Masato Kimura
14:00 -- 14:40	Prof. Wen-Wei Lin	14:45 -- 15:10	Prof. Jay Chu
14:45 -- 15:10	Prof. Hiroshi Fujiwara	15:10 -- 15:35	Mr. Takayuki Bandou
15:10 -- 15:40	Group photo & Break	15:35 -- 16:05	Break
Chairman: I-Liang Chern		**Chairman:** I-Kun Chen	
15:40 -- 16:05	Mr. Tomoki Uda	16:05 -- 16:30	Prof. Wei-Fan Hu
16:05 -- 16:30	Prof. Jinn-Liang Liu	16:30 -- 16:55	Prof. Yuusuke Iso
Chairman : Tai-Ping Liu		16:55 -- 17:05	Closing Remark (Hitoshi Imai, Jyh-Hao Lee)
16:35 -- 17:15	Prof. Takaaki Nishida	18:30 --	Banquet (for invited guests)
18:15	Reception at 1F, Howard International House		

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Semi-discrete upwind finite volume methods for the 2D stationary radiative transport equation by GPGPU

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Abstract

We show numerical analysis and computations of a semi-discrete finite volume method to the two-dimensional stationary radiative transport equation

$$\xi \cdot \nabla_x I + (\mu_{\rm s} + \mu_{\rm a})I - \mu_{\rm s} \int_{S^1} p(\xi, \xi') I(x, \xi')\, d\sigma_{\xi'} = q,$$

which is a mathematical mode of near-infrared light propagation in human tissue [1]. The collocation method is conventionally used in discretization of $\xi \in S^1$ [2, 3], while we employ piecewise constant approximation. We show unique existence of the solution to the proposed scheme, and an error estimate with some numerical examples. Since our scheme is a semi-discrete form, its realization requires sufficiently accurate numerical integration on each element and it consumes long computational time. To overcome this, the effective use of GPU (Graphics Processing Unit) is also discussed in the presentation.

References

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2016 Taiwan-Japan Joint Workshop on Numerical Analysis and Scientific Computation
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A talk on
Clifford analysis in boundary elements and yield surfaces

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Abstract

In this talk we first formulate Clifford algebra valued boundary integral equations and develop their boundary elements for plane complex and space quaternion valued harmonic functions, space $\mathcal{C}\ell_3(\mathbb{C})$-valued k-monogenic functions, and space anisotropic vector potential functions. In the development, Dirac-type operators, Cauchy-type kernels, Clifford algebra valued Stokes' theorem play the fundamental roles, and a novel procedure is devised which combines the merits of analytical evaluations of singularity and numerical quadrature for any geometry shape. In the second part of the talk we explore the Clifford group and its subgroups, especially Spin groups and Lorentz groups, and their roles in characterizing the evolutions of yield surfaces. For these groups the defining maps, namely the twisted adjoint representations may well be taken advantage of to update the stress points automatically on the yield surfaces, evolving or not in stress space. This offers tremendous computational benefits for structural and solid elastoplastic (thermo-)mechanics.

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Phase field model for crack propagation and some applications

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Abstract

We consider a phase field model for crack propagation proposed in [1, 2, 3]. We suppose that $\Omega \subset \mathbf{R}^m$ ($m = 2$ or 3) is a bounded elastic body without crack. Let $u(x,t) \in \mathbf{R}^m$ be the displacement field. The strain and stress tensors are denoted by $e[u] = (e_{ij}[u])$ and $\sigma[u] = (\sigma_{ij}[u]) = Ce[u]$, where $C = (c_{ijkl})$ is the elasticity tensor.

We introduce the following smooth phase field variable $z(x,t) \in [0,1]$ to represent the approximate profile of the crack, which satisfies $z(x,t) \approx 1$ around the crack and $z(x,t) \approx 0$ for the other region. We suppose that the damaged stress tensor is defined as $\tilde{\sigma}[u] := (1-z)^2\sigma[u]$. Our phase field model for crack propagation consists from the following equations:

$$\begin{cases} -\mathrm{div}\left((1-z)^2\sigma[u]\right) = f(x,t) & (x \in \Omega,\ t > 0), \\ \alpha\dfrac{\partial z}{\partial t} = \left(\varepsilon\ \mathrm{div}\,(\gamma(x)\nabla z) - \dfrac{\gamma(x)}{\varepsilon}z + \sigma[u] : e[u](1-z)\right)_+ & (x \in \Omega,\ t > 0), \end{cases}$$

with suitable boundary and initial conditions. In this talk, some applications of the above model to thermal stress problem and others will be presented. This talk is based on the joint works with T. Takaishi, G. Akagi, A. Sayadin, and T. Nakano.

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Applications of boundary element method to topology optimization problems

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Abstract

The boundary element method is applied to solutions of topology optimization problems. The so-called level set method [1] is used to control the boundary shape of the material distribution by solving a reaction diffusion equation whose source term is the topological derivative of the appropriately defined objective functional. In using the boundary element method for the analysis for the material distribution which changes in the optimization process, the boundary of the domain is explicitly extracted from the iso-surface of the level set function corresponding to the boundary, and then discretized automatically into boundary elements. Based on this approach, the Robin type boundary conditions, etc. can be applied to the newly generated boundary, and additional objective function term can also be considered on these boundaries. As an example of topology optimization problems, topological derivatives are shown for various boundary conditions and objective functions on the boundary generated by the topology change. Some numerical examples are shown for two-dimensional heat conduction problems [2], three-dimensional acoustic problems [3], and three-dimensional elastostatic problem.

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Applications of the kernel-free boundary integral method

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Abstract

The kernel-free boundary integral method is a generalized boundary integral method for systems of elliptic partial differential equations. It is kernel-free in the sense that there is no need to know the analytical expressions for the kernels of the boundary and volume integrals in the solution of the boundary integral equations for the elliptic PDEs. Evaluation of a boundary or volume integral is replaced with interpolation of a Cartesian grid based solution, which satisfies an equivalent discrete interface problem, while the interface problem is solved by a fast solver in the Cartesian grid. The computational work involved with the generalized boundary integral method is essentially linearly proportional to the number of grid nodes in the domain. We will present numerical experiments to demonstrate the efficiency and accuracy of the method for both boundary value problems and interface problems including the heterogeneous interface problem, where the elliptic PDEs on two sides of the interface are of different types.

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Computation of scattering of a plane wave from multiple prolate spheroids using collocation multipole method

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ABSTRACT

Collocation multipole method is presented to solve three-dimensional acoustic scattering problems with multiple prolate spheroids subjected to a plane sound wave. To satisfy the three-dimensional Helmholtz equation in prolate spheroidal coordinates and the radiation condition at infinity, the scattered field is formulated in terms of radial and angular prolate spheroidal wave functions. Instead of using the complicated addition theorem of prolate spheroidal wave functions, the multipole method, the directional derivative and the collocation technique are combined to solve multiple scattering problems semi-analytically. For the sound-hard or Neumann conditions, the normal derivative of the acoustic pressure with respect to a non-local prolate spheroidal coordinate system is developed without any truncation error for multiply-connected domain problems. By truncating the higher order terms of the multipole expansion, a finite linear algebraic system is obtained and the scattered field is determined from the given incident acoustic wave. Once the total field is calculated as the sum of the incident field and the scattered field, the near field acoustic pressure and the far field scattering pattern are determined. Numerical experiments for convergence are performed to provide the guide lines for the proposed method. The proposed results of acoustic scattering by one, two and three prolate spheroids are compared with those of an available analytical method and the boundary element method to validate the proposed method. Finally, the effects of the eccentricity of a prolate spheroidal scatterer, the separation between scatterers and the incident wave number on the near-field acoustic pressure and the far-field scattering pattern are investigated.

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Finite difference method on a scale of Banach spaces

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Abstract

We consider finite difference approximation for abstract Cauchy problems on a scale of Banach space, which contain the Cauchy problems of partial differential equations of the normal form. We show convergence of the finite difference scheme applied to the abstract Cauchy problems and it implies convergence of finite difference schemes for ill-posed Cauchy problems of the normal form, of which the example is harmonic continuation. The results hold for both the linear cases and the non-linear cases.

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