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DAYS ON DIFFRACTION 2014

ABSTRACTS

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many problems such as photonic crystal simulation using unstructured meshes is not necessary. Here we extend finite volume scheme from [1, 2] to structured meshes. The scheme employs a technique for gradient calculation and two alternative techniques for gradient limitation near dielectric permittivity discontinuity. Scheme was tested for problems with linear and curvilinear discontinuities for TE and TM waves. Test results support second order of approximation in space and time.

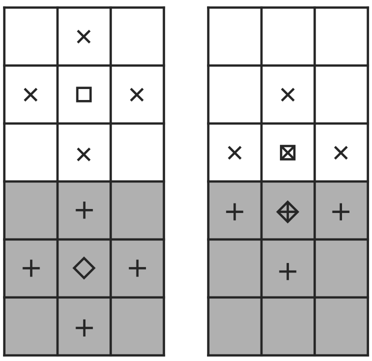

Fig. 1: Gradient calculation

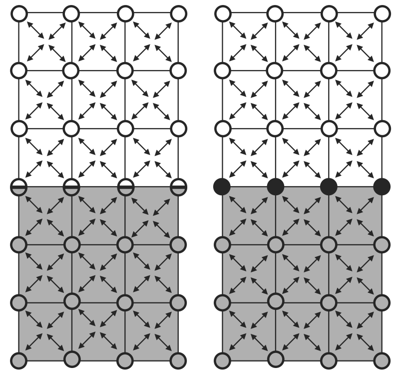

Fig. 2: Gradient limitation

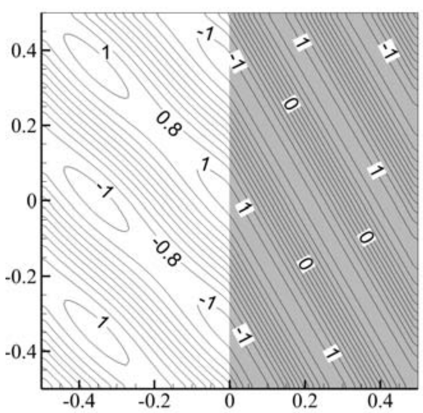

Fig. 3: Curvilinear discontinuity

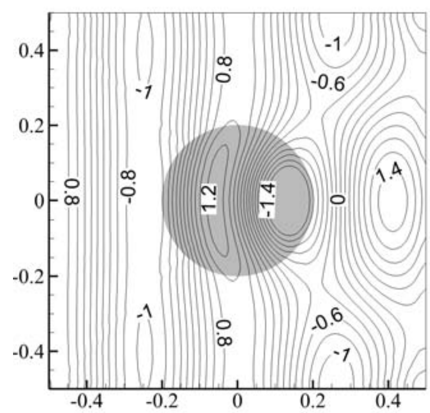

Fig. 4: Linear discontinuity

References

[1] T. Z. Ismagilov, Second order scheme for Maxwell's equations with discontinuous electromagnetic properties. *Lect. Notes Comput. Sc.*, **7125**, 227–233 (2012).

[2] T. Z. Ismagilov, A second-order scheme for Maxwell's equations with dielectric permittivity discontinuities and total field-scattered field boundaries. *Int. J. Comput. Math.*, **89**, 1378–1387 (2012).

An inverse eigenvalue problem of the theory of optical waveguides

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Inverse eigenvalue problems arise in a remarkable variety of applications, including system and control theory, geophysics, molecular spectroscopy, particle physics, structure analysis, and so on. An inverse eigenvalue problem concerns the reconstruction of a physical system from prescribed spectral data. The spectral data involved may consist of the complete or only partial information of eigenvalues or eigenvectors.

We present a new method for calculation of permittivity of dielectric materials using optical fiber's propagation constant measurements. This problem is an inverse eigenvalue problem of the optical waveguide theory. We obtain a mathematical model of eigenmodes of a weakly-guiding step-index arbitrarily shaped optical waveguide. By methods of the integral equations theory we prove that it is enough to measure the propagation constant of the fundamental eigenmode only at one frequency for the reconstruction of unknown dielectric constant of this waveguide. We present a new numerical algorithm for the calculation of the dielectric constant based on approximate solution of a nonlinear nonselfadjoint inverse eigenvalue problem for a system of weakly singular integral equations. The convergence and quality of this numerical method we prove by numerical experiments.

Monodromy of Heun equations with apparent singularities

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Heun and confluent Heun equations when one regular singularity is apparent singularity are under consideration. Corresponding connection matrices are calculated in explicit form.

The Dunkl–Darboux differential-difference operators and integrability

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Let $\mathfrak{F}$ be a space of the differentiable functions on $\mathbb{R}$; $\hat{s}$ be a reflection operator, so that $\hat{s}[f](x) = f(-x)$, $f(x) \in \mathfrak{F}$, and $\omega(x)$, $x \in \mathbb{R}$, be a even analytical function in an open domain $D_\omega \in \mathbb{R}$.

We consider the Dunkl–Darboux differential-difference operators in $\mathbb{R}$

$$\widehat{\nabla}_\omega = \frac{d}{dx} - (\ln|\omega(x)|)'\hat{s}. \tag{1}$$

Here the prime is a derivative of the function.

If $\omega(x) = |x|^k$, $k \in \mathbb{Z}_{\geqslant 0}$, then the operators (1) are the classical Dunkl operators [1]

$$\widehat{\nabla}_{|x|^k} \equiv \nabla_k = \frac{d}{dx} - \frac{k}{x}\,\hat{s}.$$

In a case which is connected with the Burchnall–Chaundy polynomials the operators (1) were studied in [2].

The question of integrability for the operators $\widehat{\nabla}_\omega$ is associated with the Cherednik algebra

$$\mathcal{A} = \langle 1, x, \frac{d}{dx}, \hat{s}\rangle.$$

In this algebra we consider the operator equality

$$\widehat{\nabla}_\omega V = V\frac{d}{dx}, \quad \text{where} \tag{2}$$

$$V = \sum_{i=0}^{N} f_i(x)\frac{d^i}{dx^i} + \sum_{i=N+1}^{2N} f_i(x)\frac{d^{N-i+1}}{dx^{N-i+1}}\,\hat{s}, \tag{3}$$

N is a natural number, $f_i(x) \in \mathfrak{F}$.