Discontinuous Galerkin Spectral Elemen/Finite Element Time Domain (DG-SE/FETD) Method for Anisotropic Medium

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Time domain methods, such as spectral element time domain (SETD) and finite element time domain (FETD) methods have potentials in solving transient and nonlinear problems. SETD method is suitable for the space with only coarse structures. Because large elements in SETD will not bring large geometric error. However, the high-order hexahedrons in SETD method can achieve good accuracy with low spatial sampling density. While tetrahedrons in finite element time domain (FETD) method can seize the detailed geometry information of the fine structures in the computational region, but the low-order elements in FETD is not high efficient as SETD in DoFs. Thus a hybrid of them via discontinuous Galerkin (DG) method can inherit the advantages of both methods. Riemann Solver is used to deal with the energy communication between adjacent subdomains.

Conventional discontinuous Galerkin time domain (DGTD) methods are based on the variables **E** and **H**. To suppress the spurious modes, this scheme needs one-order-difference basis functions for **E** and **H** (**E**n**H**n+1 or **E**n+1**H**n)**.** However, in the proposed discontinuous Galerkin spectral element finite element time domain (DG-SE/FETD) method, **EB** scheme is used, which is free of the spurious modes with the same order basis functions for **E** and **B** (**E**n**B**n). This property makes **EB** scheme more economic in DoFs than **EH** scheme. Some multiscale problems, which are difficult for conventional methods, such as FDTD or **EB** scheme DGTD, could be solved by the **EB** scheme DG-SE/FETD method.

Earlier research on DGTD method mainly focus on isotropic medium. In our research, more generalized anisotropic **EB** scheme Riemann Solver and well-posed time domain perfectly matched layer (PML) are proposed and implemented. Combined with the **EB** scheme DG-SE/FETD method, the forward modeling for transient multiscale problems in arbitrary anisotropic and lossy medium for open space can be achieved. This method will have wide applications in geophysics, such as well logging and ground penetrating radar, etc.