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Extended finite element method with simplified spherical harmonics approximation for the forward model of optical molecular imaging. (English) Zbl 1261.92030

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Summary: An extended finite element method (XFEM) for the forward model of 3D optical molecular imaging is developed with simplified spherical harmonics approximation (SP_N). In the XFEM scheme of SP_N equations, the signed distance function is employed to accurately represent the internal tissue boundary, and then it is used to construct the enriched basis function of the finite element scheme. Therefore, the finite element calculation can be carried out without the time-consuming internal boundary mesh generation. Moreover, the required overly fine mesh conforming to the complex tissue boundary which leads to excess time cost can be avoided. XFEM conveniences its application to tissues with complex internal structure and improves the computational efficiency. Phantom and digital mouse experiments were carried out to validate the efficiency of the proposed method. Compared with standard finite element method and classical Monte Carlo (MC) method, the validation results show the merits and potential of the XFEM for optical imaging.

MSC:

92C55 Biomedical imaging and signal processing
65N30 Finite element, Rayleigh-Ritz and Galerkin methods for boundary value problems involving PDEs
35Q92 PDEs in connection with biology, chemistry and other natural sciences

Software:

XFEM

Full Text: DOI

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