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An interpolation-based fast multipole method for higher order boundary elements on parametric surfaces

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In this article, a black-box higher order fast multipole method for solving boundary integral equations on parametric surfaces in three spatial dimensions is proposed. Such piecewise smooth surfaces are the topic of recent studies in isogeometric analysis. Due to the exact surface representation, the rate of convergence of higher order methods is not limited by approximation errors of the surface. An element-wise clustering strategy yields a balanced cluster tree and an efficient numerical integration scheme for the underlying Galerkin method. By performing the interpolation for the fast multipole method directly on the reference domain, the cost complexity in the polynomial degree is reduced by one order. This gain is independent of the application of either (mathcal{H})- or (mathcal{H}ˆ2)-matrices. In fact, several simplifications in the construction of (mathcal{H}ˆ2)-matrices are pointed out, which are a by-product of the surface representation. Extensive numerical examples are provided in order to quantify and qualify the proposed method. In this article, a black-box higher order fast multipole method for solving boundaryăintegral equations on parametric surfaces in three spatial dimensions is proposed. Such piecewise smooth surfaces are the topic of recent studies in isogeometricăanalysis. Due to the exact surface representation, the rate of convergence ofăhigher order methods is not limited by approximation errors of the surface.ăAn element-wise clustering strategy yields a balanced cluster tree and anăefficient numerical integration scheme for the underlying Galerkin method. By performing the interpolation for the fast multipole method directly onăthe reference domain, the cost complexity in the polynomial degree is reducedby one order. This gain is independent of the application of either H - or H 2- matrices. In fact, several simplificationsin the construction ofă H 2 -matrices are pointed out, which are a by-product of the surface representation. Extensive numerical examples are providedăin order to quantify and qualify the proposed method.
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