Quadratic Raviart-Thomas Potentials

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Abstract

We propose an efficient algorithm for the computation of a function of the Raviart-Thomas finite element space of degree 2, $\mathbf{u}_h \in RT_{h,2}$, with assigned divergence $g_h \in P_{h,1}$, being the latter the space of piecewise linear finite elements. The algorithm is based on graph techniques. The key point is to notice that for very natural basis of $RT_{h,2}$ and $P_{h,1}$, the matrix associated to the divergence operator is a reduced incidence matrix of a particular graph. Choosing a spanning tree of this graph it is possible to identify an invertible square submatrix of the divergence matrix and to compute the desired potential $\mathbf{u}_h$. The algorithm is an extension to the three dimensional space $RT_{h,2}$ of the one proposed in [2] for Raviart-Thomas finite elements of degree 1 (see also [1]). This procedure can be also used to construct a basis of the space of divergence free Raviart-Thomas finite elements of degree two.

References

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