FUNCTION RECONSTRUCTION FROM INTEGRAL DATA USING EXPONENTIALLY WEIGHTED ENRICHMENTS OF THE CROUZEIX–RAVIART FINITE ELEMENT

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The reconstruction of functions from integral data is a fundamental task in various scientific and engineering applications. In this work, we propose two novel families of weighted polynomial enrichments for the Crouzeix–Raviart finite element to develop accurate approximation operators for bivariate function reconstruction. The proposed enrichments are based on exponential Gegenbauer-weighted quadratic and cubic polynomials, which depend on two parameters, $\sigma > 0$ and $\lambda > -1/2$. These parameters enable better adaptation to localized features of the function being reconstructed, particularly for functions with low regularity or oscillatory behavior. As a result, the proposed enriched finite elements significantly enhance the approximation capabilities of the classical Crouzeix—Raviart finite element, providing greater flexibility and accuracy in capturing sharp gradients, oscillations, and other intricate features. Numerical experiments demonstrate the effectiveness of the proposed approach, showing substantial improvements in reconstruction accuracy compared to the standard Crouzeix–Raviart finite element.

References

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