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Spectral/hp element methods : Implementation to application

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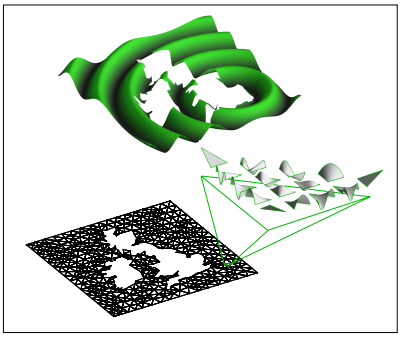

FIGURE 1 – Spectral/hp element decomposition into h sized triangles within which we apply pth-order polynomial expansions. In this example we observe the solution using a $p = 4$ polynomial triangular expansion within each elemental domain.

Spectral/hp element methods are a form of high order finite element method which combines the fast spatial convergence properties of spectral methods with the geometric flexibility of finite element/volume methods. Under appropriate conditions these techniques converge exponentially fast for an algebraic increase in computational cost. This property implies the spectral/hp element method are able to achieve a fixed error for a lower computational cost when compared to more traditional low order finite element methods. The practice is of course more complicated than the theory and achieving this benefit can strongly depend on the error one wishes to achieve and how the method is implemented. Nevertheless the techniques has successfully been applied to a range of problem including fluid mechanics (including bioflows), electromagnetics and oceanography. In this series of seminars we will start by outlining the discretisation technique, then discuss challenges of implementing them efficiently and finally demonstrate how we have applied the method in complex geometry flows.