High-order boundary layer analysis using B-splines on hybrid unstructured meshes ALVIN ZHANG, ONKAR SAHNI, RPI — Boundary layer flows are present in many engineering applications. In such flows, boundary layers span only a fraction of the characteristic length of the problem near the walls and possess large velocity gradients in the wall normal direction. This mandates use of a layered and graded mesh with a dense anisotropic h-resolution near the walls in order to accurately resolve the boundary layer. To account for complex geometries, a hybrid unstructured mesh approach is adopted. In this approach, the mesh is decomposed into wall normal and wall parallel directions. An alternative to an anisotropic h-resolution is to use a similar setting for both h- and p-resolution possibly with greater smoothness. For this purpose a mixed B-spline basis becomes attractive, where B-splines are used in the wall-normal direction and a C0 basis in the wall-parallel directions as well as the fully unstructured region of the mesh. A mixed B-spline basis offers several advantages over the traditional C0 basis utilized in finite element methods, which include greater accuracy per degree-of-freedom, ease of p-refinement as well as potential for k-refinement. In this study we demonstrate that the mixed B-spline basis, defined for the hybrid unstructured mesh, accurately models the boundary layer behavior.

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