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# A SEMI-STRUCTURED METHOD FOR HIGH-ORDER CURVILINEAR MESHING

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The generation of high-order curvilinear meshes for complex geometries and high Reynolds numbers presents a challenge due the requirement of generating elements in the boundary layers that are stretched in the direction of the flow with ratios of 1000 to 1 or higher.

Generating this type of high-order meshes is difficult for approaches based on elasticity that globally curve a linear boundary conforming mesh by projecting generating additional points in the linear mesh, project the boundary nodes on the boundary onto the curved surface and deform the mesh to accommodate them [1, 3] or alternatively undertake expensive optimization to untangle it [2].

The idea that we present is conceptualy simple but very effective and modular since it permits the generation of a sequence of meshes with increased resolution with very little additional cost which should prove very valuable for mesh convergence studies at high Reynolds numbers. We propose an isoparametric approach [4] where a mesh that contains a valid coarse discretisation into high-order triangular prisms of the boundary layer is subdivided to obtain a finer prismatic or tetrahedral boundary-layer mesh. The validity of the prismatic mesh provides a suitable mapping that, with a careful choice of the element shape functions, permits to obtain very fine mesh resolutions across the thickness of the boundary layer.

Figure 1 provides an illustration of the procedure. The initial coarse mesh that contains large triangular prismatic elements in the boundary-layer region is depicted in Figure 1(a). The prismatic elements are split long the normal to obtain a finer discretization, shown in Figure 1(b), which is suitable for the representation of viscous flows at high Reynolds numbers. If a full tetrahedral mesh is required, the prismatic mesh is split into tetrahedral elements leading to the mesh of Figure 1(c).

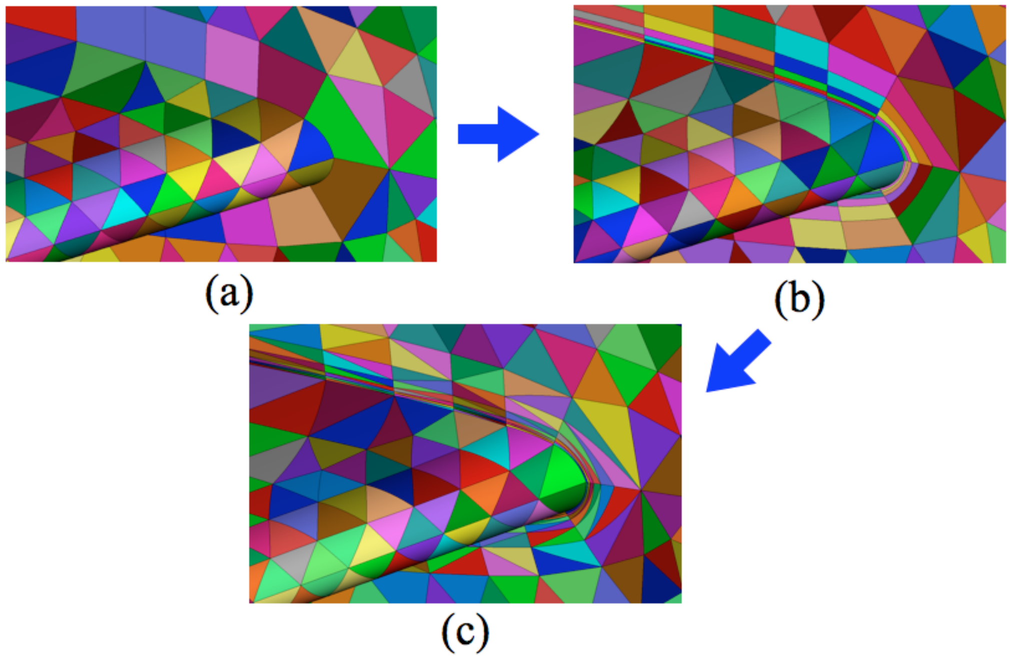

Figure 1: An illustration of the proposed procedure: (a) initial coarse mesh; (b) split of the boundary layer prisms in the direction normal to the boundary; and (c) the prismatic mesh is subdivided to obtain a flully tetrahedral mesh.

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