Algebraic–Hyperbolic Grid Generation with Precise Control of Intersection of Angles *

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Abstract

A new approach to construct high quality meshes for flow calculations is investigated in the context of algebraic grid generation. In particular, the angle of intersection between two alternate coordinate lines can be specified by the user. The construction principle is similar to well–known techniques which are used to transform a non–orthogonal grid into an orthogonal grid. From an initial grid, new coordinate lines in **one** parameter direction are determined by solving a set of ODEs. These trajectories intersect the alternate coordinate lines of the initial grid in a prescribed angle. Finally, the points of intersection are interpolated by a (planar) B–spline surface. Thus the grid can be accessed evaluating the generated parametric representation of the computational domain.

Investigations of several test configurations have shown that useful grids with high resolution can be computed from the B–spline representation only depending on a **small number of locally chosen parameters**. Therefore, only few computational memory is required for storing these parameters and evaluating the grid function can be efficiently performed at reduced computational costs. This is particularly promising when the mesh has to be frequently changed or updated in time.

1 Introduction

Algebraic grid generation is a very efficient methodology by which a curvilinear grid can be computed (see e.g. [TZM85]). However, there occur severe drawbacks when applied to the discretization of PDEs related to grid foldings, lack of orthogonality and discontinuities in metric coefficients. These phenomena are caused by the limited possibilities of controlling grid properties. For example, Coons patches [Coo74] are computed from boundary–dependent properties, e.g. point distribution, derivatives, curvature, etc., and appropriate blends [GH73] by which the grid properties in the interior are globally determined. Alternatively, algebraic systems based on transfinite interpolation (see e.g. [Son85, TZM85]) where the interpolation functions can be interpreted as nonlinear blend functions are more flexible with respect to local control of grid properties. Here, the quality of the resulting grid mainly depends on the choice of control points, e.g. deBoor points in B–spline representations, which have to be chosen judiciously. Despite these local techniques, for Navier–Stokes type of grids, i.e., thin boundary layers are to be resolved, a lack of robustness occurs in the interior of domains with complex boundary shape and curved surfaces, respectively. Therefore, algebraically generated grids are mainly used in the context of elliptic grid generation as an initial guess for the iterative solution of the nonlinear Poisson equations. Nevertheless, there is one useful feature inherent in the concept

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