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REDUCED PARAMETER SET SURFACE CONSTRUCTION FROM A GENERIC B-SPLINE SURFACES

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Abstract: Shape optimization is a rather complex undertaking which involves many challenges but nevertheless becomes a necessity in several industries. In shape optimization, the system subject to optimization is usually described by partial differential equations. In engineering application of shape optimization, the optimization problems usually contain multiple mutually conflicting objectives functions, modeled by very different computational methods. This causes difficulties in engineering applications of methods developed specially for solving a specific type of partial differential equations. A generic method for solving such problems is to construct a numerical workflow with various interconnected software. The optimizer controlling the shape variations within the numerical workflow is also a major concern. Depending on the optimization problem, a different optimization algorithm (genetic algorithm, gradient method,…) may be appropriate. In engineering shpe optimization, the notions of geometry and shape are the 'common denominator' shared by all the components of the engineering analysis and synthesis procedures. With an adequate geometry parameterization, the number of shape variables can be reduced therby decreese the optimization complexity. For engineering application, the obtained shape needs to be manufacturable. This means that a generic shape described by for example B-spline surface is not fully applicanble and the constraints can be implemented directly in the shape representation therby reducing the number of variables. To obtain a simplified shape, it can be segmented into multiple patches described by simple analytical functions. The aim of this paper is to develop a simplified geometry representation of a generic shape (usually represented by a B-spline surface) as sets of simple partial shape portions. At first, this was conducted using the results from an optimization procedure where a B-spline surface was used. The optimized object was the blade of a vertical axis wind turbine. The shape in the optimization procedure was described by a B-spline surface and the result is a complex shape which cannot be described by a simple analytical function. The shape was subsequently partitioned by several methods using approximation techniques. The performance (as defined by the optimization procedure) of the initial shape (B-spline) is compared to the shape obtained by the simplified geometry represented by a set of simple partitions. The same procedure was also analysed for using a point cloud obtained from a 3D scanning. The promising results were discussed regarding the possible reduction of shape variables.