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2D DELAUNAY MESH GENERATION WITH AREA/ASPECT-RATIO CONSTRAINTS*

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Abstract. There are several quality criteria for generating a triangular mesh of a Planar Straight Line Graph (PSLG) domain, being the most common that angles of triangles are neither too small nor too large. Delaunay refinement mesh generation algorithms have taken place in this context [3, 2, 4, 1, 5]. However, some problems require a certain granularity (average triangle area) of the mesh, instead of an angle restriction. Applying area constraints without taking into account the angles is not ideal for mesh generation because, in most cases, the resulting mesh can have many long and skinny triangles. In this context we devote our efforts to study area based constraints, combining the Delaunay criterion with an improvement process that consists in maximizing the minimum area or minimizing the difference between the maximum and minimum areas. Following this idea, we continue with the study of an aspect-ratio quality measure, that avoids triangles with relatively small areas. To those objectives we have designed algorithms that achieve the required constraints by moving, deleting or inserting Steiner vertices from or into the mesh. We also have studied combinations of an area or aspect-ratio constraint with the angle constraint. In particular, applying a preprocess which considers an area or aspect-ratio constrain allows us to obtain an adequate granularity which benefits the posterior use of the angle criterion, achieving refined Delaunay triangulations with less triangles than when only the angle criterion is applied. This combination of methods can be used to facilitate tasks like the automatic adaptation of a PSLG to a physic problem or the dynamic insertion and deletion of elements into and from a PSLG.

Keywords: Delaunay triangulation, mesh generation and refinement, area/aspect ratio constraint.

Mathematics Subject Classifications (2000): 65L50, 65M50, 65N50.

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