Graph Theory & Surface Reconstruction

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Abstract

The purpose of this paper is to utilize a technique for recreating models of 3-D objects. This process is referred to as surface reconstruction, which replaces a set of sample points using a faceted geometric model. Concepts of graph theory are used, specifically duals of graphs, n-regular graphs, bridgeless graphs, and matchings.

Introduction

The paper will refer to the triangulation of a 3-D surface given in the figure below.

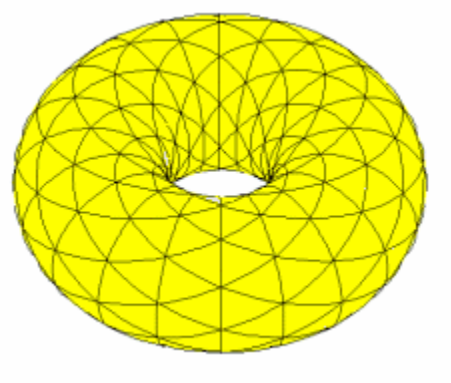

Figure 1: A torus.

The figure resembles a torus, which is created by revolving a circle along a line made by another circle. Divisions of polygonal faces that form the torus produces triangular faces throughout the torus.

Dual Graph

By definition, the planar dual of any planar graph, G, can be constructed by placing a vertex in each region of G and then adding edges between regions that share a border. The planar dual is denoted as D(G).

If a dual of the torus is to be constructed, the same procedure to create the dual of a planar graph will be used. A point will be placed in each of the triangular faces, then lines

between pairs of vertices would be placed, if and only if, the corresponding faces share a common side. The dual of the torus is constructed below.

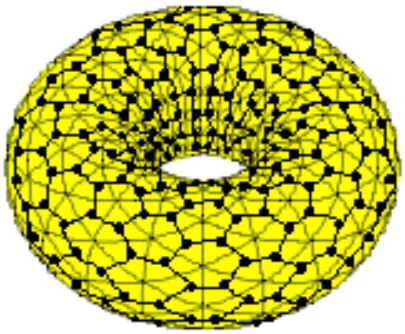

Figure 2: Dual of a torus.

As shown in the figure, the triangular faces of the original torus are hexagonal faces in the dual of the torus.

n-regular Graph