REQUEST FOR REFERENCES
FOR PATENT APP. NO. 12/687,996:
METHOD FOR GENERATING AND BUILDING SUPPORT STRUCTURES WITH DEPOSITION-BASED DIGITAL MANUFACTURING SYSTEMS

I. BASIC APPLICATION DATA:

a. **App Number:** 12/687,996
b. **Assignee:** STRATASYS, INC., Eden Prairie, MN (US)
c. **Prior Art Cutoff Date:** Jan. 15, 2010
d. **Availability for Challenge:** Expires as soon as the examiner acts (any day now)

II. APPLICATION OVERVIEW

This patent is for a method to calculate and generate support structures in printed 3D models. The method claimed essentially creates smooth shells inside of the 3D printed object. Specifically, the method works by mathematically generating shapes within the outer boundary of each layer of the object to be printed. Repeated application of this method on each successive support structure layer makes for additional, slightly-offset layers of the support structure.

III. WHY IT MATTERS:

This application describes an easily implemented way to generate and create a support structures for printed 3D objects using basic mathematics. Support structures help hobbyists print a wider variety of forms, and we suspect that many, including in the open source community, have already experimented with this type of support structure.

IV. INDEPENDENT CLAIMS & REFERENCES NEEDED

a. **Claim 1**

A computer-implemented method for generating data for a support structure to be built with a deposition-based digital manufacturing system, the method comprising:

providing a boundary polygon of a layer of the support structure;
generating a convex hull polygon based on the boundary polygon;
offsetting the convex hull polygon inward;
offsetting the boundary polygon outward; and
generating an intersection boundary polygon based at least in part on the offset boundary polygon and the offset convex hull polygon.

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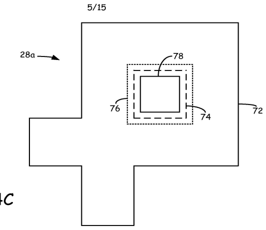

FIG. 4C

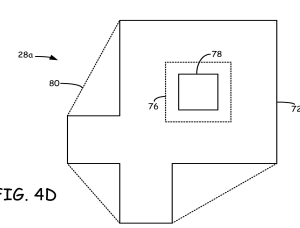

FIG. 4D

The most outward bounding line in Fig. 4C represents the "boundary polygon." Figure 4D illustrates the "convex hull polygon."

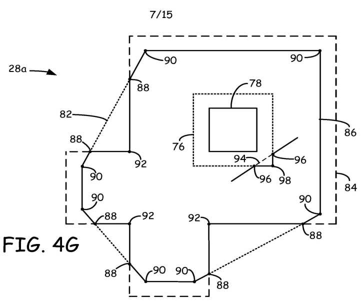

FIG. 4G

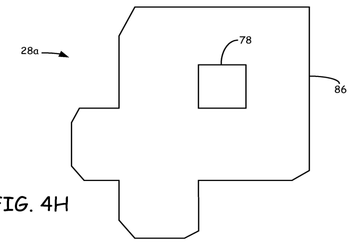

FIG. 4H

Fig. 4G and Fig. 4H show how the inwardly offset convex hull and the boundary polygon are merged to created the "intersection boundary polygon" in Fig. 4H, which is essentially a smoothed, inwardly offset shell that fits inside the original boundary polygon.

<u>We need references that describe the building of a support structure by:</u>

- **<u>setting a boundary polygon</u>**
- **<u>drawing a "hull" polygon around it</u>**
- **<u>offsetting the hull polygon inward</u>**
- **<u>generating an intersecting polygon based on a boundary polygon and its inwardly offset convex version (resulting in a smoothed, inset version of the boundary polygon, per Figure 4H).</u>**

Additional claims that elaborate on Claim 1 ("dependent claims") recite an inner boundary polygon that may be offset inward (a similar process, but reversed in direction to accommodate interior features), and a "safety zone" polygon to prevent the inner and outer boundaries from intersecting, to preserve the strength of the build. Ideal prior art will include such elements as well.

b. Claim 8

A computer-implemented method for generating data for a support structure to be built with a deposition-based digital manufacturing system, the method comprising:

providing vertices defining a boundary polygon for a layer of the support structure;

generating vertices of a convex hull polygon based on the vertices of the boundary polygon;

offsetting the vertices of the convex hull polygon inward to provide an offset convex hull polygon;

offsetting the vertices of the boundary polygon outward to provide an offset boundary polygon; and

generating an intersection boundary polygon having vertices, wherein at least a portion of the vertices of the intersection boundary polygon are selected from the group consisting of a vertex that is located at an intersection of the offset boundary polygon and the offset convex hull polygon, a vertex of the offset boundary polygon located inside of the offset convex hull polygon, *a vertex of the offset convex hull polygon located inside of the offset boundary polygon, and combinations thereof.*

This claim and its dependent claims are comparable to Claim 1, but rephrased by describing the computational steps as being based on vertices. **The same art relevant to Claim 1 will be relevant here, and ideally such art will explicitly state that polygons are computationally represented and manipulated based on data defining their vertices.**

c. Claim 15

A method for building a support structure with a deposition-based digital manufacturing system, the method comprising:

generating a convex hull polygon based on a boundary polygon for each of a plurality of layers of the support structure;

offsetting the convex hull polygon inward for each of the plurality of the layers;

offsetting the boundary polygon for each of the plurality of the layers;

generating an insert boundary polygon for each of the plurality of layers based at least in part on the offset boundary polygon and the offset convex hull; and

generating a tool path for each of the plurality of layers based at least in part on the insert boundary polygon;

transmitting the generating tool paths to the deposition-based digital manufacturing system; and

building the support structure based at least in part on the transmitted tool paths, wherein the support structure has substantially convex dimensions.

Once again, this claim and its dependent claims are highly similar to Claim 1. The additional element here is attachment to an actual 3D printer. Ideal prior art will be similar to that provided for Claim 1, but will include 3D printing rather than merely being a mathematical process.