

THIS OPINION WAS NOT WRITTEN FOR PUBLICATION

The opinion in support of the decision being entered today (1) was not written for publication in a law journal and (2) is not binding precedent of the Board.

Paper No. 17

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte MIWA OOKA
and
TETSUZO KURAGANO

Appeal No. 1996-2027
Application 07/965,079¹

ON BRIEF

Before HAIRSTON, BARRETT, and FRAHM, Administrative Patent Judges.

FRAHM, Administrative Patent Judge.

DECISION ON APPEAL

Appellants have appealed to the Board from the examiner's final rejection of claims 5 to 9,

¹ Application for patent filed October 22, 1992.

which constitute all of the claims pending in the application.²

BACKGROUND

The subject matter on appeal is directed to a method and apparatus for forming an object based on free-form surface data. As indicated in the specification (page 1), the invention is particularly applicable to CAD/CAM design in three-dimensional space. Appellants recognized that the prior art suffered from the problem that free-form curves used in wire-frame models of the objects to be formed must be represented by Bezier curves (see specification, page 5), the Bezier curves in turn being made up of contours consisting of a series of points, wherein it can be difficult to shape an object having a surface geometry which changes smoothly as intended by a designer (see specification, pages 4 to 5). To overcome this problem, appellants provide a free-form surface forming method and apparatus for generating Bezier curves which reproduces designed objects more accurately and faithfully.

Independent claim 5, which is representative of Group I, is reproduced below:

5. A method of forming an object on the basis of data representing a free-form surface, the method comprising the steps of:

generating control points between two nodal points on a three-dimensional space;

generating a free-form curve represented by a vector function using a predetermined parameter on the basis of said nodal points and control points;

setting a start point and an end point of an input series of points as said nodal points and temporarily setting said control points on the basis of points adjoining said start point and said end point

² Claims 1 to 4 were canceled as per appellants' first amendment dated November 18, 1994.

of said input series of points;

finding said parameter of a plurality of intersections with said free-form curve by drawing perpendiculars from each point of said input series of points to said free-form curve determined by said nodal points and said control points;

resetting said control points such that the total sum of distances from the respective points of said input series of points to said free-form curve determined by the parameter is minimized;

forming said free-form curve assimilated to said input series of points by means of said set nodal points and the reset control points;

generating a free-form surface on the basis of said assimilated free-form curve;

transmitting data representing said free-form surface to a tool path forming unit;

generating at said tool path forming unit processing data on the basis of said data representing said free-form surface; and

molding an object on the basis of said processing data, said object being a physical embodiment of said free-form surface.

Independent claim 6, which is representative of Group II, is reproduced below:

6. A method of forming an object on the basis of data representing a free-form surface, the method comprising the steps of:

setting internal control points in a framing space surrounded by boundary curves on a three-dimensional space;

superimposing a reference patch represented by a predetermined vector function on said framing space on the basis of said boundary curves and said internal control points;

finding, on the basis of coordinate data of a plurality of input points, the shortest distance from each of said plurality of input points to said reference patch;

generating a second patch on the basis of said internal control points such that the total sum of said shortest distances is minimized;

generating a free-form surface on the basis of said second patch;

transmitting data representing said free-form surface to a tool path forming unit;

generating at said tool path forming unit processing data on the basis of said data representing said free-form surface; and

molding an object on the basis of said processing data, said object being a physical embodiment of said free-form surface.

Independent claim 8, which is representative of Group III, is reproduced below:

8. A method for forming an object on the basis of data representing a free-form surface, the method comprising the steps of:

setting internal control points in a framing space surrounded by boundary curves on a three-dimensional space;

superimposing a patch to be transformed represented by a predetermined vector function on said framing space on the basis of said boundary curves and said internal control points;

setting a plurality of input points on said patch to be transformed;

finding the shortest distances from said plurality of input points to a second patch, said second patch being a target of transformation;

setting internal control points in the framing space of said first patch to be transformed such that the total sum of said shortest distances is minimized;

transforming said first patch such that said first patch has a surface geometry of said transformation target in the framing space of said patch to be transformed;

generating a free-form surface on the basis of said transformed first patch;

agreement that claims 5 to 9 on appeal should stand or fall in three distinct groupings: Group I consisting of claims 5 and 9; Group II consisting of claims 6 and 7; and Group III consisting of claim 8. We are in agreement with this grouping of the claims. Accordingly, we take independent claim 5 on appeal as being representative of Group I; we take independent claim 6 on appeal as being representative of Group II; and we take independent claim 8 on appeal as being representative of Group III. 37 CFR § 1.192(c)(7) (1995).

In reaching our conclusion on the issues raised in this appeal, we have carefully considered appellants' specification and claims, the applied references, and the respective viewpoints of appellants and the examiner. As a consequence of our review, we are in general agreement with appellants (Brief, pages 9 to 12) that claims 5 to 9 on appeal would not have been obvious to one of ordinary skill in the art at the time the invention was made in light of the collective teachings of Foley and Riley. For the reasons which follow, we will not sustain the decision of the examiner rejecting claims 5 to 9 under 35 U.S.C. § 103.

We first turn to appellants' argument with respect to Group I (Brief, pages 9 to 10), that Foley fails to teach the temporary setting of control points recited in representative claim 5 on appeal. We agree with appellants that Foley's Hermite curves in Figure 11.14 shown at page 486 are "merely a comparative illustration intended to demonstrate the dependence of the shape of Hermite curves on the

length of their respective target vectors," and that Foley's Hermite curves are not generated by temporary setting of control points as required by representative claim 5. We also agree with appellants' argument (Brief, page 10) that the generation of these Hermite curves is not necessary or employed in Foley for the purpose recited in claim 5 of minimizing distances between an input series of points and a free-form curve. Our review of the text of the Foley reference from pages 483 to 488, which describes Hermite curves, and from pages 507 to 510 which describes curve fitting, reveals nothing which would have fairly taught or suggested the recited features of appellants' claim 5. We also agree with appellants that "Foley also does not show the drawing of perpendiculars from the input series of points to the free-form curve in order to find the parameter relating to the intersections with the free-form curve" (Brief, page 11). We cannot agree with the examiner (Answer, page 9) that the use of the word "closer" at page 508 of Foley means that perpendiculars are being drawn or that a distance is being minimized as set forth by the claims on appeal. Accordingly, we will not sustain the rejection under 35 U.S.C. § 103 of Group I (claims 5 and 9) on appeal.

We turn next to appellants' argument with respect to Group II (Brief, pages 10 to 11), that Foley fails to teach or suggest finding the shortest distance from input points to a reference patch or generating a second patch on the basis of internal control points as recited in representative claim 6 on appeal. We are in agreement with appellants. Our review of pages 507 to 510 of Foley, upon which the examiner relies to show these features, fails to reveal any teaching or suggestion of the specific

method of finding the shortest distance from input points to a reference patch, or of generating a second patch, as required by representative claim 6. Accordingly, we cannot sustain the rejection under 35 U.S.C. § 103 of Group II (claims 6 and 7) on appeal.

Lastly, we turn to appellants' argument with respect to Group III (Brief, pages 11 to 12), that Foley fails to teach or suggest finding the shortest distances from input points to a second patch designated as a transformation target or transforming the first patch to have a surface geometry of the transformation target. We cannot agree with the examiner (Answer, page 11) that pages 508 to 510 of Foley teaches finding the shortest distances from input points to a second patch designated as a transformation target. At best, pages 508 to 510 of Foley generally show minimizing distances between points. We also cannot agree with the examiner (Answer, page 12) that sole Figure 16.26 at page 743 of Foley teaches transforming the first patch to have a surface geometry of the transformation target as required by representative claim 8. Accordingly, we cannot sustain the rejection under 35 U.S.C. § 103 of Group III (claim 8) on appeal.

In view of the foregoing, the decision of the examiner rejecting claims 5 to 9 under 35 U.S.C. § 103 is reversed.

REVERSED

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Application 07/965,079

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Administrative Patent Judge)	
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LEE BARRETT)	
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