

THIS OPINION WAS NOT WRITTEN FOR PUBLICATION

The opinion in support of the decision entered today (1) was not written for publication in a law journal and (2) is not binding precedent of the Board.

Paper No. 21

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte MATTHEW N. PAPAKIPOS,
CARROLL PHILIP GOSSETT,
CHRISTIAN PAPPAS, HENRY P. MORETON,
and ROBERT J. WILLIAMSON

Appeal No. 2002-1491
Application 08/845,526¹

ON BRIEF

Before LEE, LANE and MEDLEY, Administrative Patent Judges.

LEE, Administrative Patent Judge.

DECISION ON APPEAL

This is a decision on appeal under 35 U.S.C. § 134 from the examiner's rejection of appellant's claims 1, 2, 6-9, 12-16 and 18-25. No claim has been allowed. Claims 3-5, 10, 11 and 17 have been cancelled.

References relied on by the Examiner

Oha	5,202,670	April 13, 1993
Luken, Jr. ("Luken")	5,278,948	January 11, 1994

¹ Application for patent filed April 25, 1997.

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Gharachorloo et al. (“Gharachorloo”)	5,488,684	January 30, 1996
Schulmeiss	5,717,847	February 10, 1998
Jia et al. (“Jia”)	5,726,896	March 10, 1998
Sherman et al. (“Sherman”)	5,734,756	March 31, 1998

The Rejections on Appeal

Claims 1, 2, 6, 8 and 13-15 stand rejected under 35 U.S.C. § 103 as being unpatentable over Jia, Gharachorloo, Luken, and Schulmeiss.

Claim 7 stands rejected under 35 U.S.C. § 103 as being unpatentable over Jia, Gharachorloo, Luken, Schulmeiss, and Sherman.

Claims 9 and 12 stand rejected under 35 U.S.C. § 103 as being unpatentable over Luken, Jia, Schulmeiss and Sherman (Answer at 2).

Claims 16, 18 and 19 stand rejected under 35 U.S.C. § 103 as being unpatentable over Luken, Jia, and Schulmeiss.

Claims 20-24 stand rejected under 35 U.S.C. § 103 as being unpatentable over Luken and Gharachorloo.

Claim 25 stands rejected under 35 U.S.C. § 103 as being unpatentable over Luken, Gharachorloo, and Oha.

The Invention

The claimed invention is directed to an apparatus and method for displaying 3D graphics on a display by using a graphics rendering pipeline to render a NURBS (non-uniform rational B-splines) defined curve or surface. According to the discussion of prior art in the applicant's specification (Spec. pp. 6-7), prior art systems first transform the NURBS model of curve or surface into a representation in polygon meshes on a separate processor before calling on special dedicated rendering hardware, e.g., a graphics rendering pipeline, to render the curve or surface represented by a polygonal mesh. According to the summary of invention in the specification (Spec. p. 8), the method and system of the present invention accurately renders NURBS models without first burdening the data transfer bandwidth of the computer system (e.g., from separate processor to dedicated rendering hardware), and does not consume an inordinate amount of separate processor clock cycles (needed by processing curve or surface as a polygonal mesh).

The Summary of the Invention portion of the applicant's appeal brief states, in pertinent part:

The process of the present invention functions by receiving a NURBS model for rendering from a software program running on the one or more host processors (e.g., processors 1502 of figure 15). The NURBS model defines a curve or surface. The process efficiently converts the NURBS model to a Bezier model using the hardware of the graphics rendering pipeline (e.g., graphics rendering pipeline 301 of figure 15). The Bezier model describes the same curve or surface. The process of the present invention subsequently generates a plurality of points on the curve or surface using the Bezier model and the graphics rendering pipeline. The points on the surface are then used by the graphics rendering pipeline to render the curve or surface defined by the Bezier model.

The appellant's specification has no special definition for the term "render" in the graphics context. However, the Gharachorloo reference explains this term of art in its Background of the Invention portion as follows (Column 1, lines 26-29):

To "render" a graphics entity is to convert the entity from its high level form ultimately to pixel data, which is stored in a frame buffer having a location for each pixel being displayed.

That explanation is consistent with how the term is used in the appellant's specification.

The independent claims are claims 1, 9, 13, 16, and 20, of which claims 1 and 9 expressly state that the NURBS defined curve or surface is rendered without first converting the NURBS defined curve or surface to a polygonal mesh, and claim 20 recites a method of using the graphics rendering pipeline to render a curve or surface "directly" from a NURBS (non-uniform rational B-spline) model.

Claim 1 is reproduced below:

1. In a computer system having a processor, a bus, and a graphics rendering pipeline for displaying 3D graphics on a display, a computer implemented method for rendering a NURBS defined curve or surface without first converting the NURBS defined curve or surface to a polygon mesh, the method comprising the computer implemented steps of:

a) receiving a NURBS model for rendering from a software program running on the processor of the computer system;

b) converting the NURBS model to a Bezier model using the graphics rendering pipeline;

c) generating a plurality of Bezier control points from a corresponding plurality of NURBS control points using a tri-linear interpolator in the graphic pipeline by:

- c1) using the plurality of NURBS control points as inputs to the tri-linear interpolator; and
- c2) evaluating the NURBS control points to obtain each of the plurality of Bezier control points;
- d) generating a plurality of points on a curve or surface, wherein the curve or surface is defined by the Bezier model, using the graphics rendering pipeline; and
- e) rendering the curve or surface defined by the NURBS model using the plurality of points and using the graphics rendering pipeline such that the curve or surface is rendered without first converting the NURBS model to a polygon mesh.

Discussion

A. The Rejection of Claims 1, 2, 6, 8 and 13-15 for Obviousness over Jia, Gharachorloo, Luken, and Schulmeiss

At the outset, it is noted that in the Argument section of the appellant's brief, aside from simply identifying the patentability of claims 13, 14, and 15 as an issue, the appellant nowhere discusses claims 13, 14, and 15 in relation to the prior art references applied by the examiner to show any patentable distinction therefrom. We decline to play the role of counsel for the appellant by trying to see if some of the arguments made with respect to other claims might have equal applicability in the context of claims 13, 14 and 15. The rejection of claims 13, 14 and 15 will be sustained because the appellant has not shown error with respect to these claims.

Claims 2, 6, and 8 each depend directly or indirectly from independent claim 1 and thus include all the features of claim 1. These claims are about displaying 3D graphics on a display by receiving as input a NURBS defined curve or surface and by using a graphics rendering pipeline without converting the NURBS defined curve or surface to a polygon mesh.

Independent claim 1 requires using the graphics rendering pipeline (1) to convert the NURBS model to a Bezier model and generating a plurality of Bezier control points from a corresponding plurality of NURBS control points using a tri-linear interpolator in the graphics pipeline, (2) to generate a plurality of points on a curve or surface defined by the Bezier model, and (3) to use those generated plurality of points to render the NURBS defined curve or surface without first converting the NURBS model to a polygon mesh.

The examiner cites the Jia reference as teaching converting a NURBS surface model to a Bezier surface model, evaluating a plurality of NURBS control points into Bezier control points, and interpolating a plurality of control points (Answer at 4-5). But the Jia reference is not about displaying any 3D graphics on a display and it is not about rendering any graphics entity.

Rather, it is directed to computerized numerical control of the motions of a machine tool. It is apparent that Jia's system includes no graphics rendering pipeline and the examiner has not found that it does. The examiner acknowledges on page 5 of the Answer (lines 2-4) that Jia fails to teach receiving data from a host and rendering it. Note that claim 1 requires all of the above-noted actions to be accomplished by the graphics rendering pipeline or some component within the rendering pipeline.

The examiner attempts to account for the missing graphics rendering pipeline by citing to the Gharachorloo reference. As is stated by the examiner (Answer at 5): "Gharachorloo et al. teach a method to receive data from a host processor into a graphics pipeline, and use the

graphics pipeline to render the object (refer Figs. 1, 2, 2A).” But the effort is without merit since Gharachorloo’s graphics rendering pipeline does not perform these tasks: (1) to convert the NURBS model to a Bezier model and generating a plurality of Bezier control points from a corresponding plurality of NURBS control points using a tri-linear interpolator in the graphics pipeline, (2) to generate a plurality of points on a curve or surface defined by the Bezier model, and (3) to use those generated plurality of points to render the NURBS defined curve or surface without first converting the NURBS model to a polygon mesh. In contrast, Gharachorloo’s graphics rendering pipeline exemplifies that which the appellant’s specification describes as belonging to the prior art, i.e., those which do the rendering by first converting the NURBS model to a polygon mesh.

The combination of Jia and Gharachorloo in the manner as proposed by the examiner reflects the application of improper hindsight in light of the applicant’s own disclosure. The examiner has not set forth persuasive reasoning why one with ordinary skill in the art would operate a graphics rendering pipeline, not according to how any cited prior art graphics rendering pipeline is used, but according to how numerical machine tools are controlled according to the Jia reference. In that regard, we recognize that the examiner has made the following statement on the top of page 5 of the Answer, and in bold: “Jia also teaches generating a curve without first converting the NURBS defined curve to a polygon mesh (Fig. 5).” If by “generating” the examiner intends “displaying a 3D graphics” or “rendering,” the statement is not supported by the cited evidence. As is described in column 8, lines 4-11 of Jia, Figure 5 is an example of a

cubic B-spline curve represented by piecewise Bezier curves and Figure 5 shows the same cubic curve shown in Figure 2, described instead by its equivalent Bezier control polygons B6-B10, all in the context of providing computerized numerical control of a machine tool. The discussion of the curve is in the context of explaining computerized numerical control of the motion of a machine tool involving the curve. The examiner has cited to nothing which indicates that the curve can or should be rendered by a graphics rendering pipeline by use of the same or similar procedures as applied to numerical control of a machine tool.

The rejection of claims 1, 2, 6 and 8 is **reversed**.

The rejection of claims 13, 14 and 15 is **affirmed**.

B. The Rejection of Claim 7 for Obviousness over
Jia, Gharachorloo, Luken, Schulmeiss, and Sherman

Claim 7 depends from claim 6 which in turn depends from claim 1. The Sherman reference was added by the examiner to account for the feature additionally recited in claim 7 as compared to claim 6. The deficiency of the basic rejection of claims 1, 2, 6 and 8 as discussed above is not cured or overcome by the additional reliance on the Sherman reference.

Accordingly, the rejection of claim 7 is **reversed**.

C. The Rejection of Claims 9 and 12 for Obviousness
over Luken, Jia, Schulmeiss, and Sherman

Claim 12 depends from independent claim 9. Claim 9 recites a method for rendering NURBS defined curves or surfaces using the graphics rendering pipeline of a computer system without first converting the NURBS defined curve or surface to a polygon mesh. The method

requires implementing a de Casteljau process in the graphics pipeline, evaluating a Bezier curve or surface using the de Casteljau process, implementing the de Casteljau process using a trilinear interpolator in the graphics pipeline, and rendering the Bezier curve or surface without first converting the Bezier curve or surface to a polygon mesh.

The examiner cites to the Luken reference for its disclosure of a graphics rendering pipeline using a de Casteljau process to evaluate a b-spline curve in NURBS form. It is acknowledged by the examiner that Luken does not teach using the graphics pipeline to evaluate a Bezier curve or surface as is required by claim 9 (Answer at page 10). Nonetheless, the examiner cites to the Jia reference to make up for that deficiency. As discussed above, however, the Jia reference does not disclose the “rendering” of any computer graphics. Instead, it is directed to computerized numerical control of the motions of a machine tool. The examiner has not shown that Jia’s system includes a graphics rendering pipeline or even has a need for one. While Jia’s computerized numerical control system does convert a NURBS defined curve or surface to a Bezier curve for purposes of controlling the movements of a machine tool, the examiner has not shown why one with ordinary skill in the art would have applied that teaching to a graphics rendering pipeline. While the examiner states that according to Jia the Bezier curve is a special case of the B-spline curve, the transformation into Bezier curves still requires specially chosen parameters. Although Jia discloses conversion of NURBS defined curves to a Bezier model, the examiner has not articulated a reasonable motivation for one with ordinary skill in the art to implement that conversion for use within a graphics rendering pipeline,

notwithstanding that according to the Sherman and Schulmeiss references the de Casteljaou process can be used to evaluate Bezier curves. The fact that the de Casteljaou process can be used to evaluate Bezier curves does not mean the NURBS representation of a curve and the Bezier model of the same are equivalents.

As for the examiner's statement that Jia also teaches generating a curve without first converting the NURBS defined curve to a polygon mesh, we have the same problems with it as earlier discussed in the context of the rejection of claims 1, 2, 6, 8, and 13-15.

In the Response to Argument portion of the examiner's Answer, the examiner makes a surprising statement. On page 14, in lines 15-17, the examiner states: "it is noted that Luken teaches a graphics pipeline (Fig. 2) to render the parametric surface, **and also teaches pipeline to decompose NURBS to Bezier** (Col. 1 45-50) [Emphasis added]". That statement contradicts the examiner's earlier finding on page 10 of the Answer that "Luken fails to teach the use of these methods [the various claimed steps] for a Bezier curve." Upon closer scrutiny, we see that there really is no contradiction. The examiner is only sloppy in referring to different parts of Luken. Luken's invention indeed is not described as using a Bezier curve or Bezier control points, just as the examiner found on page 10 of the Answer. The examiner's statement on page 14 of the Answer which appears to say the contrary actually refers not to Luken's disclosed invention but to a different invention referred to in the Background Art portion of Luken's specification, i.e., U.S. Patent No. 4,912,659. It is abundantly clear that the reference to Patent No. 4,912,659 is describing something different from what is implemented in Luken's own

invention. Luken describes the invention of Patent No. 4,912,659 as requiring computational resources and risks the appearance of pin holes or rips in the surface rendered on the screen (Column 1, lines 50-54). In the immediately following paragraph, Luken states that none of the known prior art fully capitalize on NURBS data in evaluating and rendering parametric surfaces and a need exists for a method and apparatus for evaluating and rendering NURBS data representative of a parametric surface, in an efficient, accurate and rapid fashion. One with ordinary skill in the art reading Luken's specification would see the use of the Bezier model as something separate and not suggested for use in combination with the steps of Luken's disclosed invention. To whatever extent the examiner is arguing that Luken's discussion of the prior art suggests that Luken's disclosed steps should be applied to a Bezier model derived from the NURBS model, the argument is without merit and rejected.

The examiner should be mindful not to mix Luken's discussions of its own invention and Luken's discussions of the prior art or to regard them as one and the same. It only serves to generate confusion and does not help to articulate a clear ground or rationale for the rejection. If Luken's discussion of Patent No. 4,912,659, particularly as it relates to the use of the Bezier curve or model, has stirred up the examiner's curiosity in what specific steps are disclosed in that reference, the appropriate action would have been to review that reference for any potential applicability in a proper rejection. On this record, based on the examiner's stated rationale, there is no reasonable basis for one with ordinary skill in the art to modify a method according to Luken's disclosed invention such that the disclosed steps are applied to a Bezier curve or model.

For the foregoing reasons, the rejection of claims 9 and 12 is **reversed**.

D. The Rejection of Claims 16, 18 and 19 for
Obviousness over Luken, Jia, and Schulmeiss

Claim 18 depends from independent claim 16, and claim 19 depends from claim 18.

Claim 16 recites a method for a graphics rendering pipeline, which includes the step of generating a plurality of surface partials from the surface by loading inputs of a tri-linear interpolator included in a graphics rendering pipeline with a plurality of Bezier control points defining the surface.

The examiner cites to the Luken reference for its inherent disclosure of the use of tri-linear interpolators. The examiner notes that the Luken reference implements a de Casteljau process which performs a linear interpolation between the components (x,y,z) of the NURBS control points. The examiner recognizes, however, that in the disclosed system of the Luken reference, Bezier control points are not inputs to the tri-linear interpolators as is required by claim 16.

For this rejection, the examiner's rationale parallels that which he used for the rejection of claims 9 and 12. He notes that according to the Jia reference the Bezier curve is a special case of a B-spline curve, and he notes that according to the Schulmeiss reference, the de Casteljau algorithm can be used to calculate Bezier control points. The rationale is insufficient to support the rejection. As we discussed above in the context of the rejection of claims 9 and 12, the Jia reference has nothing to do with the "rendering" of any computer graphics. Instead, it is directed to computerized numerical control of the motions of a machine tool. The examiner has

not shown that Jia's system includes a graphics rendering pipeline or even has a need for one. While Jia's computerized numerical control system does convert a NURBS defined curve or surface to a Bezier curve for purposes of controlling the movements of a machine tool, the examiner has not shown why one with ordinary skill in the art would have applied that teaching to a graphics rendering pipeline. While the examiner states that according to Jia the Bezier curve is a special case of the B-spline curve, the transformation into Bezier curves still requires specially chosen parameters. Also, the fact that the de Casteljau process can be used to evaluate Bezier curves does not mean the NURBS representation of a curve and the Bezier model of the same are equivalents.

With regard to the examiner's comment about the Luken reference, contained in the response to arguments portion of the examiner's Answer, note our earlier discussion on that subject in the context of our discussion of the rejection of claims 9 and 12.

For the foregoing reasons, the rejection of claims 16, 18 and 19 is **reversed**.

E. The Rejection of Claims 20-24 for Obviousness over Luken and Gharachorloo

Claims 21-24 depend directly or indirectly from independent claim 20. Claim 20 recites a method of using a graphics rendering pipeline to "render a curve or surface directly from a NURBS (non-uniform rational B-spline) model." The method includes the steps of (a) performing a global to local transformation on a NURBS model using the graphics rendering pipeline; (b) evaluating a plurality of NURBS control points using tri-linear interpolation in the graphics rendering pipeline to obtain a plurality of points on a curve or surface defined by the

NURBS model; and (c) rendering the curve or surface using the plurality of points. In the context of the applicant's specification, it is reasonably clear that "render a curve or surface directly from a NURBS model" means without first converting the curve or surface to a polygon mesh. The recitation is also not a meaningless statement of intended use, because the specific steps (b) and (c) in the body of the claim give life and meaning to the recitation by associating it with specific actions in the method. The examiner's analysis evidently has ignored that important feature of the applicant's claimed invention. On page 12 of the Answer, the examiner states: "Claim 20 lays claim to a method of rendering a curve by doing a global to local transformation, evaluating the NURBS control points using tri-linear interpolation, and rendering the curve using the points thus created." There is no mention of the requirement that the curve be rendered directly from the NURBS model, i.e., without first converting the curve or surface to a polygon mesh. In subsequent analysis on the same page of the Answer, the examiner also does not account for that feature of the claimed invention.

The applicant in his brief on page 27 asserts that the cited prior art references do not "directly" render NURBS models with the dedicated rendering hardware of the graphics pipeline. The applicant then specifically discusses Gharachorloo to show that it first creates a polygon mesh. Although the applicant does not specifically discuss Luken, the general assertion is enough to place the examiner's failure to account for the claimed feature at issue. It is the examiner who must first make out a prima facie case of obviousness by an accounting of all the claimed limitations. The examiner's silence in this regard is a problem especially because the

Summary of the Invention portion of the Luken reference indicates that its disclosed process produces a series of 4-sided polygons for subsequent rendering (Column 2, lines 28-31). We decline to undertake detailed examination ourselves to determine whether the system according to the Luken reference directly renders curves without first converting them into a polygon mesh. The examiner's failure to account for this feature of the rejected claims undermines the rejection. On this record, based on the examiner's stated rationale, the rejection of claims 20-24 cannot be sustained.

With regard to the examiner's comment about the Luken reference, contained in the response to arguments portion of the examiner's Answer, note our earlier discussion on that subject in the context of our discussion of the rejection of claims 9 and 12.

For the foregoing reasons, the rejection of claims 20-24 is **reversed**.

F. The Rejection of Claim 25 for Obviousness
over Luken, Gharachorloo and Oha

Claim 25 depends from claim 20 and adds additional steps to the process defined by claim 20. The Oha reference is applied to account for the additional steps added by dependent claim 25. Thus, as applied by the examiner, the Oha reference does not cure the deficiencies of the rejection of base independent claim 20. Consequently, the rejection of claim 25 cannot be sustained.

The rejection of claim 25 is **reversed**.

Conclusion

The rejection of claims 1, 2, 6 and 8 as unpatentable under 35 U.S.C. § 103 over Jia, Gharachorloo, Luken and Schulmeiss is **reversed**.

The rejection of claims 13-15 as unpatentable under 35 U.S.C. § 103 over Jia, Gharachorloo, Luken and Schulmeiss is **affirmed**.

The rejection of claim 7 as unpatentable under 35 U.S.C. § 103 over Jia, Gharachorloo, Luken, Schulmeiss, and Sherman is **reversed**.

The rejection of claims 9 and 12 as unpatentable under 35 U.S.C. § 103 over Luken, Jia, Schulmeiss and Sherman is **reversed**.

The rejection of claims 16, 18 and 19 as unpatentable under 35 U.S.C. § 103 over Luken, Jia, and Schulmeiss is **reversed**.

The rejection of claims 20-24 as unpatentable under 35 U.S.C. § 103 over Luken and Gharachorloo is **reversed**.

The rejection of claim 25 as unpatentable under 35 U.S.C. § 103 over Luken, Gharachorloo, and Oha **reversed**.

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No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a).

AFFIRMED-IN-PART

JAMESON LEE
Administrative Patent Judge

SALLY GARDNER LANE
Administrative Patent Judge

SALLY C. MEDLEY
Administrative Patent Judge

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) INTERFERENCES
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Appeal No. 2002-1491
Application 08/845,526

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