

The opinion in support of the decision being entered today was not written for publication and is not binding precedent of the Board.

UNITED STATES PATENT AND TRADEMARK OFFICE

---

BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES

---

Ex parte THOMAS A. GRANDINE and THOMAS A. HOGAN

---

Appeal No. 2006-2963  
Application No. 10/309,969

---

ON BRIEF

---

Before HAIRSTON, JERRY SMITH, and BLANKENSHIP, Administrative Patent Judges.

JERRY SMITH, Administrative Patent Judge.

#### DECISION ON APPEAL

This is a decision on the appeal under 35 U.S.C. § 134 from the Examiner's rejection of claims 1-30. Claims 31-33 have been indicated as containing allowable subject matter [Answer, page 3; Reply Brief, page 1].

The disclosed invention pertains to modeling at least one section of a curve utilizing a quartic interpolation technique. Each section can be modeled by initially providing a pair of positions of the curve section including associated directions and curvatures. Then, points  $b_0$ ,  $b_1$ ,  $b_2$ ,  $b_3$ , and  $b_4$  are identified based upon the pair of positions and associated directions and curvatures. A quartic interpolant is then determined over an

interval based upon the identified points thus modeling the section of the curve. Such a technique enables modeling each respective curve section such that changes in the data only affect the curve locally. As a result, a point in one section can be altered without affecting the modeled curve in subsequent sections.

Representative claim 1 is reproduced as follows:

1. A method of modeling at least one section on a curve  $f$ , wherein modeling a section comprises:

providing a pair of positions  $(f_i, f_{i+1})$  of the section of the curve, wherein the pair of positions includes associated directions  $(d_i, d_{i+1})$  and associated curvatures  $(k_i, k_{i+1})$ ;

identifying points  $b_0, b_1, b_2, b_3,$  and  $b_4$  based upon the pair of positions  $(f_i, f_{i+1})$  and associated directions  $(d_i, d_{i+1})$  and curvatures  $(k_i, k_{i+1})$ ; and

determining a quartic interpolant  $p(t)$  over an interval  $(i < t < i+1)$  based upon points  $b_0, b_1, b_2, b_3,$  and  $b_4$  to thereby model the section of the curve, wherein the Interpolant  $p(t)$  has a position, direction and curvature equal to  $f_i, d_i$  and  $k_i$ , respectively, at  $t = i$ , and wherein the interpolant  $p(t)$  has a position, direction and curvature equal to  $f_{i+1}, d_{i+1}$  and  $k_{i+1}$ , respectively, at  $t = i + 1$ .

The examiner relies on the following references:

Peters, Jörg, ("Peters"), Local Generalized Hermite Interpolation by Quartic  $C^2$  Space Curves, ACM Trans. On Graphics, Vol. 8, No. 3, p. 235-42, (1989) ("Peters").

de Boor, Carl, et al. ("de Boor"), High Accuracy Geometric Hermite Interpolation, Comp. Aided Geometric Des. 4, 269-78, (1987).

The following rejections are on appeal before us:

1. Claims 1, 8-11, 18-21, and 28-30 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Peters.

2. Claims 2-7, 12-17, and 22-27 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Peters in view of de Boor.

Rather than repeat the arguments of Appellants or the Examiner, we make reference to the briefs and the Answer for the respective details thereof.

### **OPINION**

We have carefully considered the subject matter on appeal, the rejections advanced by the Examiner and the evidence of anticipation and obviousness relied upon by the Examiner as support for the rejections. We have, likewise, reviewed and taken into consideration, in reaching our decision, the Appellants' arguments set forth in the briefs along with the Examiner's rationale in support of the rejections and arguments in rebuttal set forth in the Examiner's answer.

It is our view, after consideration of the record before us, that the disclosure of Peters fully meets the invention as set forth in claims 1, 8-11, 18-21, and 28-30. Also, we find that the evidence relied upon and the level of skill in the particular art would have suggested to one of ordinary skill in the art the obviousness of the invention as set forth in claims 2-7, 12-17, and 22-27. Accordingly, we affirm.

We first consider the rejection of claims 1, 8-11, 18-21, and 28-30 under 35 U.S.C. § 102(b) as being anticipated by Peters. Anticipation is established only when a single prior art reference discloses, expressly or under the principles of inherency, each and every element of a claimed invention as well functional limitations. RCA Corp. v. Applied DigitaData Systems, Inc., 730 F.2d 1440, 1444, 221 USPQ 385, 388 as disclosing structure which is capable of performing the recited (Fed. Cir. 1984);

W.L. Gore and Associates, Inc. v. Garlock, Inc., 721 F.2d 1540, 1554, 220 USPQ 303, 313 (Fed. Cir. 1983). Only those arguments actually made by Appellants have been considered in this decision. Arguments which Appellants could have made but chose not to make in the briefs have not been considered and are deemed to be waived [see 37 CFR § 41.37(c)(1)(vii)(2004)].

The Examiner has indicated how the claimed invention is deemed to be fully met by the disclosure of Peters [Answer, pages 3-6]. Regarding independent claims 1, 11, and 21, Appellants argue that Peters does not teach or suggest providing a pair of positions  $(f_i, f_{i+1})$ , directions  $(d_i, d_{i+1})$ , and curvatures  $(k_i, k_{i+1})$ , and determining a quartic interpolant  $p(t)$  upon points  $b_0, b_1, b_2, b_3$ , and  $b_4$  which, in turn, are based upon the provided positions, directions, and curvatures [Brief, pages 4 and 5; emphasis in original]. Appellants contend that Peters discloses that the tangent  $t$  at the specified positions  $P$  is defined based upon the  $C$  Bezier coefficients, which are, in turn, derived based upon the specified positions  $P$  [Brief, page 5]. Appellants emphasize that not only are the tangents in Peters not provided, they are determined after determining the interpolant [Brief, pages 5 and 6]. In contrast, the approach of the claimed invention necessarily determines the interpolant  $p(t)$  based upon the provided pair of directions [id.].

The Examiner argues that Peters determines coefficient  $C$  based upon positional and tangent data including the tangent length. The Examiner further notes that Peters also derives coefficients  $B_1$  and  $B_0$  based on positional, tangent, and curvature data [Answer, pages 14 and 15]. Appellants respond that determining coefficient  $C$  based on

tangent is actually counter to Peters' teachings. Rather, Peters derives coefficient C from a sequence of data points [Reply Brief, pages 2, 3, and 6]. Appellants add that even if points  $b_0 - b_4$  correspond to Bezier coefficients P,  $B_0$ , C,  $B_1$ ,  $P^+$  described in Peters, for Peters to anticipate the claim, Peters must determine the Bezier coefficients P,  $B_0$ , C,  $B_1$ ,  $P^+$  based upon a pair of positions, directions, and curvatures. Appellants contend that Peters, however, discloses just the opposite – determining tangent based upon Bezier coefficient C [Reply Brief, page 5].

The Examiner also argues that the independent claims do not require providing directions and curvature data as original fixed inputs, but rather merely recite that the pair of positions “includes” associated directions and curvatures. Therefore, the claims do not preclude directions and curvatures that are functions of positional data [Answer, pages 16 and 17]. Appellants respond that the claimed invention requires including directions and curvatures as part of the provided positions rather than merely associating the provided pair of positions, directions, and curvatures [Reply Brief, page 5].

We will sustain the Examiner's rejection of independent claims 1, 11, and 21. At the outset, we note that any point on a curve inherently has an associated direction (i.e., established by the tangent at that point<sup>1</sup>) and curvature. Therefore, the pair of

---

<sup>1</sup> Although Peters discloses defining tangent t in terms of the pair C and  $C^-$  as appellants indicate, Peters nevertheless teaches that such an approach is “somewhat less flexible than the actual prescription of tangents at each data point” [Peters, page 238; emphasis added]. Such a statement not only suggests that each point on a curve inherently has an associated tangent, but prescribing such tangents at each data point is actually more flexible than defining them in terms of the pair C and  $C^-$ .

positions  $P$  and  $P^+$  located on a curve that are chosen in Peters inherently includes associated directions and curvatures as claimed.

As the Examiner indicates, Peters determines control points  $C$  based upon positional data, tangent direction, and tangent length [Peters, page 239]. Since (1)  $C$  corresponds to one of the claimed identified points  $b_0 - b_4$ , and (2)  $C$  is determined based on positional data,  $C$  is therefore identified based upon the pair of positions as claimed. In addition, Peters determines coefficients  $B_1$  and  $B_0$  based on positional and tangent data as the Examiner indicates [Peters, page 238]. Therefore, all of the Bezier coefficients  $P$ ,  $B_0$ ,  $C$ ,  $B_1$ ,  $P^+$  described in Peters are identified based, at least in part, upon the pair of positions – positions inherently having associated directions and curvatures as we noted previously. Moreover, since the quartic interpolant in Peters is determined based upon the Bezier coefficients over an interval, all limitations of independent claims 1, 11, and 21 are therefore fully met by Peters.

For the above reasons, we will sustain the Examiner's anticipation rejection of independent claims 1, 11, and 21. Since Appellants have not separately argued the patentability of dependent claims 8-10, 18-20, and 28-30, these claims fall with the independent claims. See In re Nielson, 816 F.2d 1567, 1572, 2 USPQ2d 1525, 1528 (Fed. Cir. 1987). See also 37 CFR § 41.37(c)(vii).

We next consider the Examiner's rejection of claims 2-7, 12-17, and 22-27 under 35 U.S.C. § 103(a) as being unpatentable over Peters in view of de Boor. Regarding claims 2, 5, and 6, the examiner's rejection essentially finds that Peters discloses all of the claimed subject matter except for identifying a control point based on the convex

combination of multiple points [answer, pages 7 and 11]. The Examiner cites de Boor as teaching defining various points based on a convex combination of multiple points and concludes that it would have been obvious to one of ordinary skill in the art at the time of the invention to utilize such a technique in Peters' method to guarantee the solvability of the coefficients for the quartic interpolant and concavity of the Bezier polygon used to generate the quartic interpolant [Answer, pages 7, 8, and 11-13].

Regarding claims 3 and 4, the Examiner adds that Peters discloses all of the claimed limitations except for defining a control point as a point at the intersection of (1) a line through point  $P$  parallel to direction  $t$ , and (2) a line through  $P^+$  and parallel to direction  $t^+$  [Answer, pages 8 and 9].

The Examiner cites de Boor as teaching defining the control point as the intersection of tangents through  $P$  and  $P^+$ , and concludes that it would have been obvious to one of ordinary skill in the art at the time of the invention to utilize such a technique in Peters' method to, among other things, guarantee the solvability of coefficients associated with the quartic interpolant [Answer, pages 8-10].

Appellants argue that combining de Boor with Peters as proposed by the Examiner is improper because Peters teaches away from the technique disclosed in de Boor [Brief, page 7; Reply Brief, pages 6 and 7]. Appellants note that Peters explains that the motivation for the disclosed technique is derived from an analysis of a technique disclosed by Höllig. Höllig's technique, however, is a modification of the de Boor technique. Based on this sequence of improvements, Appellants conclude that Peters' technique is not complementary to Höllig's technique, but rather an alternative to

Höllig's technique, and therefore de Boor's technique [Brief, page 7]. The Examiner argues that determining whether a prima facie case of obviousness is established is not based on whether one reference teaches away from combining prior art references, but rather on whether a teaching, suggestion, or motivation exists to combine the references and whether the skilled artisan would reasonably expect success if the references were so combined [Answer, page 19].

We will sustain the Examiner's obviousness rejection of claims 2-7, 12-17, and 22-27. At the outset, we note that Appellants have not contested the Examiner's technical reasoning recited in the rejection on pages 6-14 of the Answer apart from arguing that Peters teaches away from de Boor. In this regard, Appellants have not persuasively rebutted the Examiner's position regarding the perceived differences between Peters and the claimed invention, and the Examiner's interpretation of the scope and content of de Boor as teaching or suggesting the limitations of claims 2-7, 12-17, and 22-27 that are absent from Peters.

Accordingly, the sole issue before us is whether the de Boor reference is properly combinable with Peters. In making this assessment, we recognize that we must consider the cited references in their entirety, including portions that teach away from the claimed invention. See W.L. Gore & Associates, Inc. v. Garlock, Inc., 721 F.2d 1540, 220 USPQ 303 (Fed. Cir. 1983). See also MPEP § 2141.02(VI). But "obviousness must be determined in light of all the facts, and there is no rule that a single reference that teaches away will mandate a finding of nonobviousness." Medichem, S.A. v. Rolabo, S.L., 437 F.3d 1157, 1165, 77 USPQ2d 1865, 1870 (Fed.

Cir. 2006). “A reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant.” In re Kahn, 441 F.3d at 990, 78 USPQ2d at 1338 (Fed. Cir. 2006) (quoting In re Gurley, 27 F.3d 551, 553, 31 USPQ2d 1130, 1131 (Fed. Cir. 1994)).

After carefully reviewing the respective teachings of Peters and de Boor, we find that the skilled artisan would have been reasonably motivated to apply the teachings of de Boor to Peters’ technique essentially for the reasons stated by the Examiner in the rejection. Although Peters improves upon the earlier de Boor technique as Appellants indicate, this fact hardly forecloses combining the references if they are otherwise properly combinable. In short, de Boor is prior art for all that it teaches, and on the record before us, we find that the references are reasonably combinable in the manner suggested by the Examiner.

In the rejection, the Examiner relied upon de Boor merely to show that it was well known in the art to define various points based on a convex combination of multiple points, and define the control point as the intersection of tangents through P and P<sup>+</sup> [Answer, pages 7-13].

Significantly, Appellants do not dispute this position, nor dispute that such a modification to Peters would result in the advantages noted in the rejection. Rather, Appellants argue that the references are not properly combinable [Brief, page 7; Reply brief, pages 6 and 7]. Based on the totality of the record before us, however, we find

Appeal No. 2006-2963  
Application No. 10/309,969

that the skilled artisan would have reasonably relied on de Boor's teachings essentially for the reasons stated by the Examiner in the rejection. The Examiner's obviousness rejection of claims 2-7, 12-17, and 22-27 is therefore sustained.

In summary, we have sustained the Examiner's rejection with respect to all claims on appeal. Therefore, the decision of the Examiner rejecting claims 1-30 is affirmed.

Appeal No. 2006-2963  
Application No. 10/309,969

No time period for taking any subsequent action in connection with this appeal  
may be extended under 37 CFR § 1.136(a)(1)(iv).

**AFFIRMED**

KENNETH W. HAIRSTON	)	
Administrative Patent Judge	)	
	)	
	)	
	)	
	)	
JERRY SMITH	)	BOARD OF PATENT
Administrative Patent Judge	)	APPEALS AND
	)	INTERFERENCES
	)	
	)	
	)	
HOWARD B. BLANKENSHIP	)	
Administrative Patent Judge	)	

JS/JJ/gw

Appeal No. 2006-2963  
Application No. 10/309,969

ALSTON & BIRD LLP  
BANK OF AMERICA PLAZA  
101 SOUTH TRYON STREET, SUITE 4000  
CHARLOTTE, NC 28280-4000