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NOTES

IN RE WARMERDAM: WHEN IS A SOFTWARE PROCESS TOO ABSTRACT TO MERIT PATENT PROTECTION?

I. INTRODUCTION

The United States continues to lead the world in granting patent protection for computer programs.[1] Unlike many foreign countries, however, the United States does not have an explicit rule that defines software as unpatentable subject matter.[2] Despite the United States' leadership position in patent protection, U.S. case law defining patentable subject matter has evolved slowly and painfully.[3] The legal controversy restricting software patentability stems from the principle that abstract ideas are not patentable.[4] Because the courts have had difficulty distinguishing unapplied ideas from those applied in software, functional and useful programs have frequently been ruled as unpatentable abstract ideas.[5] This difficulty also exists within the United States

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1. *See* Michael J. Lennon, *Patents and Computer Software in the United States*, PATENT WORLD, July/Aug. 1994 at 6.

2. EUROPEAN PATENT CONVENTION, ARTICLE 52(2)(c). *But see* Eric Oliver, *Patentability of Computer Program Related inventions in the US and Abroad*, PATENT WORD, Mar. 1993, at 30 (Mr. Oliver explains that despite *per se* prohibitions against computer programs as patentable subject matter, "the major software supplying countries in the world, *i.e.*, the US, Europe, Germany, France, Japan, the UK, and Canada, afford the same basic patent protection to computer program related inventions.").

3. *See generally* 1 DONALD S. CHISUM, PATENTS §1.03[6] (1993), wherein Professor Chisum traces the two main lines of cases that led to the development of the current law on the patentability of computer programs and mathematical algorithms back to the mid-19th century.

4. *See* Peter J. Ayers, Note, *Interpreting In re Alappat with an Eye Towards Prosecution*, 76 J. PAT. [& TRADEMARK] OFF. SOC'Y 741 (1994).

5. *See* Gottschalk v. Benson, 409 U.S. 63 (1972) (holding that a method for converting BCD to Binary is not patentable); *In re* Walter, 618 F.2d 758, 205 U.S.P.Q. 397 (C.C.P.A. 1980) (holding that a method of correlating responses to seismic test signals is not patentable); *In re* Abele and Marshall, 684 F.2d 902, 214 U.S.P.Q. 682 (C.C.P.A. 1982) (holding that a method for calculating and displaying data is not patentable); *In re* Grams, 888 F.2d

Patent and Trademark Office ("PTO"). The PTO remains uncomfortable in granting patents for inventions ideally embodied[6] as software.[7] Likewise, computer programs that employ mathematical algorithms[8] may be regarded as patentable subject matter, but only within certain limitations.[9] Inventors of such processes are attempting to secure broader protection for their inventions. Inventors' attorneys continue to test these boundaries and the PTO continues to reject patent applications for software inventions based on the grounds that they constitute non-statu-

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835, 12 U.S.P.Q.2d 1824 (Fed. Cir. 1989) (holding that a method of diagnosing an abnormal condition in an individual is not patentable); *In re* Schrader, 22 F.3d 290, 30 U.S.P.Q.2d 1455 (Fed. Cir. 1994) (holding that a method for competitively bidding is not patentable); Parker v. Flook, 437 U.S. 584 (1987); *In re* Meyer and Weissman, 215 U.S.P.Q. 193 (C.C.P.A. 1982).

6. 35 U.S.C. §112 requires patent applicants to disclose "the best mode contemplated by the inventor of carrying out his invention." 35 U.S.C. §112(1) (1994). An invention involving an algorithm is likely to find its best mode embodiment as a computer program. *See* WEBSTER'S NEW WORLD DICTIONARY OF COMPUTER TERMS 12 (5th ed. 1994).

7. *See* Stephen G. Kunin, *Patentability of Computer Related Inventions in the United States Patent Trademark Office*, 76 J. PAT. & TRADEMARK OFF. SOC'Y 149,150 (1994)(Speaking of computer implemented processes involving the execution of a computer program, Mr. Kunin, the Acting Assistant Commissioner for Patents in the PTO at the time, laments that "the courts have not provided the USPTO with bright line guidance for the examination process."). *See also* Daniel J. Kluth, *Mathematical Algorithms on Appeal: Recent Decisions by the Board of Patent Appeals*, 10 COMPUTER LAW 12, 16 (1993). *See also* Lee E. Barrett, *Patentable Subject Matter: Mathematical Algorithms and Computer Programs*, 1106 OFF. GAZ. T.M. OFFICE 5 (1989); MANUAL OF PATENT EXAMINING PROCEDURES §2106 (Rev. 16, 1994) (stating that the Patent Office accepts claims related to computer programs as patentable).

Professor Chisum explains that "[s]ystems using mathematical formulae or mental systems can be patented as processes, and a process is not precluded from eligibility for patent protection merely because one step is the use of a suitably programmed digital computer." DONALD S. CHISUM, UNDERSTANDING INTELLECTUAL PROPERTY LAW, § 2C[1][f], 2-26 (1992).

8. An algorithm is defined as "[a] procedure for solving a given type of mathematical problem." *Gottschalk*, 409 U.S. at 65. The exact wording of the Supreme Court definition is significant because the Federal Circuit has used this definition to narrowly define what constitutes an algorithm. The Federal Circuit interprets the term to mean only the solution to a mathematical problem. *See, e.g., In re* Pardo, 684 F.2d 912, 916, 214 U.S.P.Q. 673, 676 (C.C.P.A. 1982); *In re* Toma, 575 F.2d 872, 877, 203 U.S.P.Q. 971, 975 (C.C.P.A. 1978); *In re* Phillips, 608 F.2d 879, 882-83 (C.C.P.A. 1979). The preferred definition of "algorithm" in the computer art is "a prescribed set of well-defined unambiguous rules or processes for the solution of a problem in a finite number of steps. Commonly used as integral parts of computer programs; thus, the study of computers and that of algorithms are closely related." WEBSTER'S NEW WORLD DICTIONARY OF COMPUTER TERMS 12 (5th ed. 1994). However, there is no universal agreement on the definition. Another definition is that "[a]n algorithm is an unambiguous specification of a conditional sequence of steps or operations for solving a class of problems." Allen Newell, *Response: The Models Are Broken, The Models Are Broken*, 47 U. PITT. L. REV. 1023, 1024 (1986).

9. *See infra* note 10 for a list of circumstances in which the PTO regards software that uses mathematical algorithms as patentable.

tory subject matter.[10] 35 U.S.C. section 101,[11] which lists the categories of patentable subject matter,[12] limits inventions to processes, machines, articles of manufacture and compositions of matter. While an inventor may claim a program as a process, the PTO often finds that such claims merely define an unapplied, unpatentable abstract idea.[13]

The PTO's practice of rejecting software patent applications continues because the Court of Appeals for the Federal Circuit has yet to articulate a clear guideline for determining when an invention, which is best

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10. Nonstatutory subject matter refers to claimed inventions that do not fit into any of the categories of patentable subject matter under 35 U.S.C. section 101, which is entitled "Inventions Patentable." 35 U.S.C. §101 (1994). The PTO follows the following six guidelines with regard to the patenting of algorithms:

    1. [C]laims must be considered as a whole. It is inappropriate to dissect the claims into old and new elements and then to ignore the presence of the old elements in the analysis . . . . The 'novelty' of any element or steps in a process, or even of the process itself, is of *no relevance* in determining whether the subject matter of a claim falls within the 101 categories of possible patentable subject matter.

    2. When a claim containing a mathematical formula implements or applies that formula in a structure or process which, when considered as a whole, is performing a function which the patent laws were designed to protect (e.g., transforming or reducing an article to a different state or thing), then the claim satisfies the requirements of §101.

    3. When a claim recites a mathematical formula (or scientific principle or phenomenon of nature), an inquiry must be made into whether the claim is seeking patent protection for that formula in the abstract. (If the claim does seek protection for such a mathematical formula, it would be non-statutory under 35 U.S.C. §101).

    4. A mathematical formula as such is not accorded the protection of our patent laws . . . and this principle cannot be circumvented by attempting to limit the use of the formula to a particular technological environment . . . . [S]imilarly, insignificant post solution activity will not transform an unpatentable principle into a patentable process.

    5. When a claim as in *Parker v. Flook*, 198 U.S.P.Q. 193 (1978), is drawn to a method for computing an "alarm limit" (which) is simply a number, the claim is non-statutory under 35 U.S.C. 101 because *Flook* sought to protect a formula for computing this number.

    6. It is now commonplace that an *application* of a law of nature or mathematical formula to a known structure or process may well be deserving of patent protection. *Citing* Funk Bros. Seed C. v. Kalo Co., 333 U.S. 127, 76 U.S.P.Q. 280 (1948); Eibel Process Co. v. Minnesota and Ontario Paper Co., 261 U.S. 45 (1923); Cochrane v. Deener, 94 U.S. 780 (1876); O'Reilly v. Morse, 15 How. 62 (1853); and LeRoy v. Tatham, 14 U.S. (1 How.) 156 (1852).

MANUAL OF PATENT EXAMINING PROCEDURE §2106 (Rev. 16, 1994).

11. 35 U.S.C. section 101 provides: "Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title." 35 U.S.C. §101 (1994).

12. *See* Irah H. Donner, *Throwing out Baby Benson with the Bath Water: Proposing a New Test for determining Statutory Subject Matter*, 33 JURIMETRICS J. 247, 251 n.20 (1993).

13. Robert G. Sterne et al., *Preparing and Prosecuting Electronic and Computer Related Patent Applications: Avoiding and Overcoming Statutory Subject Matter Rejections*, C909 A.L.I.-A.B.A. 221, 237-238 (1994).

embodied as software, does not qualify as patentable subject matter. In a recent opinion, *In re Warmerdam*,[14] the Federal Circuit further compounded the problem by not applying appropriate precedent, and by analyzing the facts without revealing the details of its reasoning. This outcome is particularly frustrating to practitioners in view of the Federal Circuit's immediately preceding in banc decision, *In re Alappat*.[15] Before *Warmerdam*, the patent bar gratefully received the *Alappat* opinion as a powerful argument to counter PTO rejections of software claims as nonstatutory or improper preemption of algorithms.[16] Now after *Warmerdam*, it is likely that there will be more confusion in the PTO.

In *Warmerdam*, the Federal Circuit again wrestled with identifying excluded subject matter to determine the patentability of a software implemented algorithm.[17] The claimed invention in *Warmerdam* involved an algorithm for building a computer data structure. The data structure defined the physical contours of an object, in hierarchical levels of detail, for use in a collision avoidance system.[18]

Unlike previous opinions considering the patentability of software, the *Warmerdam* court correctly bypassed the pseudo "mathematical algorithm" exclusion analysis[19] and the *Freeman-Walter-Abele* test.[20] However, the court ignored relevant precedent and incorrectly limited its opinion to only the language of section 101[21] and the general principle that abstract ideas are not patentable.[22] Despite the express and implied physical characteristics of the claimed "data structure . . . in a . . . machine,"[23] the court failed to see that such a data structure[24] should be patentable under section 101. As a result, this decision leaves unclear to the PTO and the patent bar when a computer program should be patent-

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14. *In re* Warmerdam, 33 F.3d 1354, 31 U.S.P.Q.2d 1754 (Fed. Cir. 1994).

15. *In re* Alappat, 31 U.S.P.Q.2d 1545 (Fed. Cir. 1994). The *Alappat* court held that an algorithm implementable in hardware or software is not necessarily an unpatentable mathematical abstraction if it merely calculates a data structure for a display. *Id.* at 1551.

16. Ayers, *supra* note 4.

17. Judges have read exclusions into 35 U.S.C. section 101 regarding patentable subject matter that include inventions that entirely preempt the use of "laws of nature, natural phenomena, and abstract ideas." Diamond v. Diehr, 450 U.S. 175, 185, 209 U.S.P.Q. 1 (1981).

18. *Warmerdam*, 31 U.S.P.Q.2d at 1756.

19. *See Pardo*, 214 U.S.P.Q. at 675.

20. *See infra* note 70 and accompanying text for a detailed discussion of the *Freeman-Walter-Abele* test.

21. 35 U.S.C. §101 (West 1994).

22. *See infra* note 73.

23. Appellant's Opening Brief at 55, *In re* Warmerdam, 31 U.S.P.Q.2d 1754 (Fed. Cir. 1994) (No. 93-1294) (Claim 1 of the Warmerdam invention).

24. The IEEE Standard Computer Dictionary defines the phrase "data structure" as "[a] physical or logical relationship among data elements, designed to support specific data manipulation functions." IEEE STANDARD COMPUTER DICTIONARY 155 (1991).

able. However, a perceptive attorney can circumvent any section 101 rejections to software inventions by simply using the claim drafting technique of reciting physical structure in the claims.

This note will use a four-part analysis to demonstrate that the court erred in denying a patent for the invention, as claimed, in *Warmerdam*. First, this note will show that the court correctly abandoned the *Freeman-Walter-Abele* test because the test was too vague to offer meaningful guidance. Second, this note will explain how the Federal Circuit failed to consider the claims as a whole and failed to recognize the true nature of the process improvement invention. This lead the court to incorrectly characterize the invention as an unpatentable abstract idea. Third, this note will propose a continuum of abstractness using inventions that have already been evaluated for patentability under 35 U.S.C. section 101. Finally, this note will determine the proper position of the *Warmerdam* invention in relation to other inventions on the continuum.

II. SUMMARY OF FACTS

On January 28, 1993, the Patent and Trademark Office Board of Patent Appeals and Interferences ("Board") affirmed[25] an examiner's final rejection of Thomas Warmerdam's[26] process patent application[27] which claimed a method for building a data structure used in a robotic collision avoidance system.

Warmerdam's invention amounted to an improved method for determining, relating, and organizing data describing a hierarchy of safety clearance zones around an object. These clearance zones, referred to as bubbles in the art, are larger, more geometrically regular, and more easily defined by a mathematical equation than the actual objects they envelop. Thus, a determination can be made as to whether two passing objects will collide by simply determining whether their bubbles will intersect each other given the objects' paths, orientations and bubble geometries. There are in fact several layers of bubbles, each layer providing a more detailed approximation of the actual geometry of the object. Thus, once an intersection (or "bursting") of the outer most layer of a bubble is determined, an apparatus employing the claimed process is triggered to recheck bursting of inner layers to distinguish near-misses from actual collisions. Warmerdam's contribution is the new application to collision avoidance of a previously known technique for determining a data structure representative of safety zones about a physical object.

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25. Originally this matter was Appeal No. 92-3680 to the Board.

26. Thomas P. H. Warmerdam and Bernad J. H. Verwer were the joint inventors of the present subject matter. *Warmerdam*, 31 U.S.P.Q. at 1755.

27. U.S. Patent Application Serial No. 07/430,749 ("the '749 application"). Warmerdam originally filed the '749 application on November 1, 1989. *Id.*

Warmerdam's first claim[28] describes a two step process for generating the data structure:

> 1. A method for generating a data structure which represents the shape of [sic] physical object in a position and/or motion control machine as a hierarchy of bubbles, comprising the steps of:
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> first locating the medial axis of the object and
>
> then creating a hierarchy of bubbles on the medial axis.[29]

The fifth claim is for a machine containing the data structure.

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28. The other claims that depend from claim 1 are as follows:

> 2. The method of Claim 1 wherein the step of creating the hierarchy comprises a top-down procedure of:
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> first placing a root bubble which is centered at the center of gravity of the object and has a radius equal to the maximum distance from the center of gravity to the contour of the object;
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> next, if the medial axis has a plurality of branch lines, placing a plurality of first successive bubbles each of which encompasses a distinct part of the object which is described by one of said branch lines; and
>
> then successively dividing each line of the medial axis into two new line parts and placing a pair of next successive bubbles each of which encompasses a distinct part of the object which is described by one of said new line parts.
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> 3. The method of Claim 1 wherein the step of creating the hierarchy comprises a bottom-up procedure of:
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> first representing the medial axis as [sic] large plurality of discrete points;
>
> next placing the centers of a plurality of lowest level bubbles at said discrete points, where the radius of each bubble is equal to the minimum distance from the corresponding center point to the contour of the object; and
>
> then successively creating new bubbles by merging the smallest bubble remaining with its smallest neighbor(s) to create a new bubble and repeating this step until only one root bubble remains.
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> 4. The method of Claim 3 wherein two old bubbles are merged to yield a new bubble in accordance with the formulas:

$$x' = \frac{1}{2(x1+x2+ \frac{r1\text{-}r2}{j} (x1\text{-}x2))}$$

$$y' = \frac{1}{2(y1+y2+ \frac{r1\text{-}r2}{j} (y1\text{-}y2))}$$

$$z' = \frac{1}{2(z1+z2+ \frac{r1\text{-}r2}{j} (z1\text{-}z2))}$$

> wherein r1 and r2 are the radii of the old bubbles, j is the distance between the centers of the old bubbles, (x1,y1,z1) and (x2,y2,z2) are the coordinates of the center of the old bubbles, r' is the radius of the new bubble, and (x',y', z') are the coordinates of the center of the new bubble.

Appellant's Opening Brief at 55-56, *In re* Warmerdam, 31 U.S.P.Q.2d 1754 (Fed. Cir. 1994) (No. 93-1294).

29. Appellant's Opening Brief at 55-56, *In re* Warmerdam, 31 U.S.P.Q.2d 1754 (Fed. Cir. 1994) (No. 93-1294).

5. A machine having a memory which contains data representing a bubble hierarchy generated by the method of any of Claims 1 through 4.[30]

The sixth claim is for the data structure itself:

6. A data structure generated by the method of any of Claims 1 through 4. [31]

On August 11, 1994, the Federal Circuit affirmed the Board's rejection on the grounds that the application claimed nonstatutory subject matter under 35 U.S.C. section 101.[32] Specifically, the court held that claims 1 through 4 and 6 were non-statutory subject matter because they "involve[d] no more than the manipulation of abstract ideas."[33] The court reversed the Board's finding that claim 5 was indefinite under 35 U.S.C. section 112.[34]

III. ISSUES & CONCLUSIONS

The *Warmerdam* court focused on the issue of whether claims 1-4 and 6 amount to nonstatutory subject matter processes because they are "laws of nature, natural phenomena or abstract ideas."[35] The court held that both steps of the first independent claim were essentially the solving of mathematical algorithms.[36] The court concluded that claims 1-4 and 6 were not patentable under 35 U.S.C. section 101.[37] Additionally,

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30. Appellant's Opening Brief at 55-56, *In re* Warmerdam, 31 U.S.P.Q.2d 1754 (Fed. Cir. 1994) (No. 93-1294). The way this claim is phrased is equivalent to the "means for" language approved by the Patent Act for claiming a combination. The Patent Act provides:

An element in a claim for a combination may be expressed as a means or step for performing a specified function without the recital of structure, material, or acts in support thereof, and such claim shall be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof.

35 U.S.C. §112(6) (1994).

31. Appellant's Opening Brief at 55-56, *In re* Warmerdam, 31 U.S.P.Q.2d 1754 (Fed. Cir. 1994) (No. 93-1294).

Claim 7, which was allowed by the PTO, is an apparatus claim for a robotics controller:

7. A robotic controller comprising:

means for controlling the motion of one or more objects, said means for controlling responsive to a means for generating a data astructure [sic];

said means for generating a data structure representative of the shape of one ormore [sic] of said objects which includes:

a) means for calculating the position of the medial axis of said object and

b) means for creating the heirarchy [sic] of bubbles all of which have centers which are disposed on the medial axis.

Appellant's Opening Brief at 55-56, *In re* Warmerdam, 31 U.S.P.Q.2d 1754 (Fed. Cir. 1994) (No. 93-1294).

32. *Warmerdam*, 31 U.S.P.Q.2d at 1754.

33. *Id.*

34. *Id.*

35. *Id.*

36. *Warmerdam*, 31 U.S.P.Q.2d at 1754.

37. *Id.*

the court examined whether apparatus claim 5 was indefinite and therefore unpatentable under 35 U.S.C. section 112.[38] Interestingly, the court began its discussion of this issue with the observation that the fifth claim was for "a machine, and is clearly patentable subject matter"[39] under section 101.

IV. COURT'S ANALYSIS

The *Warmerdam* court began its analysis by refuting the notion that Congress, in reference to section 101, used the words "invents any new and useful process" to mean that there should not be restrictions on patentable subject matter.[40] The court reasoned that, by including things such as machines, processes, items of manufacture, and compositions of matter, Congress necessarily excluded others. The court asserted that Congress did not intend statutory subject matter to "include anything under the sun that is made by man."[41] Citing *Diamond v. Diehr*,[42] the court pointed out that "laws of nature, natural phenomena or abstract ideas"[43] are not patentable under section 101.[44]

In an effort to eschew nonstatutory language, the court dismissed the *Freeman-Walter-Abele* test[45] used by the PTO and previous courts.[46] Recognizing that the outcome of the *Freeman* test turns on the definition of a "mathematical algorithm,"[47] and that case law is unsettled on the definition of this term,[48] the court turned to the actual language of section 101 and the Supreme Court's last word on the subject.[49] The court

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38. Title 35 of the United States Code requires that "[t]he specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention." 35 U.S.C. §112(2).

39. *Warmerdam*, 31 U.S.P.Q.2d at 1754.

40. *Id.*

41. Legislative history of the 1952 Patent Act. S. REP. No. 1979, 82nd Cong., 2d Sess. 5 (1952).

42. Diamond v. Diehr, 450 U.S. 175, 185 (1981).

43. *Warmerdam*, 31 U.S.P.Q.2d at 1757.

44. *Id.*

45. *See infra* note 70 and accompanying text for a discussion of the *Freeman-Walter-Abele* test.

46. *Warmerdam*, 31 U.S.P.Q.2d at 1758.

47. In *Schrader,* the court defined "mathematical algorithm" as "a 'procedure for solving a given type of mathematical problem.'" *In re* Schrader, 30 U.S.P.Q. 1455, 1457 (Fed. Cir. 1994) *citing* Gottschalk v. Benson, 409 U.S. 63, 71-72 (1972) *and* Diamond v. Diehr, 450 U.S. 175, 186 (1981).

48. *Warmerdam*, 31 U.S.P.Q.2d at 1758.

49. The court, in referring to "mathematical algorithms," explained:
    [a]n alternative to creating these arbitrary definitional terms which deviate from those used in the statute may lie simply in returning to the language of the statute and the Supreme Court's basic principles as enunciated in *Diehr*, and eschewing efforts to describe nonstatutory subject matter in other terms.

Id.

acknowledged that a process, as defined in 35 U.S.C. § 100,[50] is equivalent to a method[51] and the Supreme Court stated in *Diehr* that "abstract ideas" are excluded from statutory subject matter.[52]

The court then reduced the section 101 issue to a dispositive test; that is, patentability depends on "whether the claim is for a process that goes beyond simply manipulating 'abstract ideas' or 'natural phenomena.'"[53] The court looked at the claimed process steps of "locating" a medial axis and "creating" a bubble hierarchy.[54] It concluded that these steps amounted to nothing more than "the manipulation of basic mathematical constructs."[55] Without further explanation, the court characterized the mere "manipulation of basic mathematical constructs"[56] as the "paradigmatic 'abstract idea'" that the Supreme Court meant to exclude from statutory subject matter.[57]

Next, the court dismissed Warmerdam's argument that the claims imply the physical measurement of the contours of a physical object, as "miss[ing] the point."[58] In analogizing to the data gathering claims of *In re Grams*,[59] the court held that a physical measurement step is nothing more than the manipulation of abstract ideas.[60] The court reasoned that from the standpoint of section 101, a physical measurement step is the same as the data gathering step held in *In re Grams* to be insufficient by itself to satisfy section 101.[61]

In a brief paragraph, the court rejected Warmerdam's contention that the manipulation of data represents adequate physical activity to satisfy section 101 requirements. The court limited the physical activity under consideration to that described in the claims and held that, as claimed, the invention lacked any significant physical activity. The court reasoned that the claims did not have the effect of "produc[ing] something quite different."[62]

The court also considered whether claim 5 failed the definiteness re-

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50. "[P]rocess means process, art or method and includes any new use of a known process, machine, manufacture, composition of matter, or material." 35 U.S.C. §100(b) (1994).

51. *Warmerdam*, 31 U.S.P.Q.2d at 1758.

52. Diamond v. Diehr, 450 U.S. 175, 185 (1981).

53. *Warmerdam*, 31 U.S.P.Q.2d at 1759.

54. *Id.*

55. *Id.*

56. *Id.*

57. *Warmerdam*, 31 U.S.P.Q.2d at 1759.

58. *Id.*

59. *In re* Grams, 12 U.S.P.Q.2d 1824 (Fed. Cir. 1989).

60. *Warmerdam*, 31 U.S.P.Q.2d at 1759.

61. *Id.*

62. *Id.*

quirement of section 112.[63] Claim 5 is a multiply dependent[64] apparatus claim that limits the processes to a computer implementation. Surprisingly, the court presumed that the claim is statutory subject matter simply because it is limited to a machine.[65]

Finally, the court dispatched the argument that a "data structure" constitutes patentable subject matter. Based on the IEEE's[66] definition of data structure,[67] the court reasoned that Warmerdam's claimed data structure amounts to "the ideas reflected in the process of making a bubble hierarchy."[68] Thus, the court concluded that absent some physical manifestation of the ideas, the claimed data structure was an abstract

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63. 35 U.S.C. section 112 requires a patent application to "contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art . . . to make and use" the invention. 35 U.S.C. § 112, para. 1 (1994).

64. A patent application may contain claims of dependent form which refer back to another claim. *See* DONALD S. CHISUM & MICHAEL A. JACOBS, UNDERSTANDING INTELLECTUAL PROPERTY LAW, §2D[3][d][ix] (1992). Professor Chisum offers the following example:

Consider the following four claims.
1. A composition comprising a fluid and soap.
2. The composition of claim 1 wherein the fluid is water.
3. The composition of claim 2 further including dye.
4. The composition recited in claim 1 or 2 wherein the soap is lye soap.

Claim 1 is an independent claim because it is self-contained and refers to no other claim. Claim 2 is a dependent claim that narrows claim 1's scope by narrowing one element. The claim 1 soap element is incorporated into claim 2. Claim 3 is a dependent claim that narrows claim 2's scope by adding an element (a dye). The claim 1 soap element and the claim 2 water element are incorporated into claim 3. Claim 4 is a multiple dependent claim that alternatively incorporates claim 1 and claim 2's elements and narrows claim 1 and 2's soap element.

Id. at § 2C[1][f].

The Patent Act provides:
[A] claim in dependent form shall contain a reference to a claim previously set forth and then specify a further limitation of the subject matter claimed. A claim in dependent form shall be construed to incorporate by reference all the limitations of the claim to which it refers.

A claim in multiple dependent form shall contain a reference, in the alternative only, to more than one claim previously set forth and then specify a further limitation of the subject matter claimed. A multiple dependent claim shall not serve as a basis for any other multiple dependent claim. A multiple dependent claim shall be construed to incorporate by reference all the limitations of the particular claim in relation to which it is being considered.

35 U.S.C. § 112, paras. 4-5 (1994).

65. *See Warmerdam,* 31 U.S.P.Q.2d at 1759.

66. The Institute of Electrical and Electronics Engineers ("IEEE") is "[a] professional engineering organization founded in 1963 for the furthering of education, research, and standards in the electronics and electrical fields. IEEE has a strong interest in computer technology. It sponsors many educational opportunities and publications for members." WEBSTER'S NEW WORLD DICTIONARY OF COMPUTER TERMS 302 (5th ed. 1994).

67. *See supra* note 24 for a definition of "data structure."

68. *Warmerdam,* 31 U.S.P.Q.2d at 1760.

idea and therefore unpatentable under section 101.[69]

V. AUTHOR'S ANALYSIS

Although the *Warmerdam* court properly avoided application of the *Freeman-Walter-Abele* test[70] for statutory subject matter, the court incorrectly held that the appellant's claims 1 through 4 and 6 did not fit into any of the section 101 categories of patentable subject matter.[71] Because of the inherent vagueness of the test,[72] application to Warmerdam's claimed invention may have resulted in finding the invention was patentable subject matter, but for the wrong reasons. Despite starting from the language of the statute and the classic statement of the section 101 exceptions,[73] the court failed to apply appropriate precedent to discern whether the claimed invention was merely an abstract algorithm or a patentable implementation of the algorithm. Finally, in recognizing that the critical defect of nonstatutory subject matter is that it fails to satisfy the usefulness requirement of section 101, the court should have adopted a test that evaluates the relative abstractness of the claimed invention for determining section 101 patentability.

A. THE DEFECTIVE *FREEMAN-WALTER-ABELE* TEST

The *Freeman-Walter-Abele* test first asks if the claims expressly or implicitly recite a mathematical algorithm. If they do not, the subject matter is statutory under section 101. Otherwise, the test further asks "whether the claimed invention as a whole is no more than the algorithm itself."[74] The Federal Circuit in *Arrhythmia Research Technology, Inc. v.*

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69. *Id.*

70. The determination of statutory subject matter has been conducted in a two-part test originally developed by the Court of Customs and Patent Appeals in *In re Freeman*, 197 U.S.P.Q. 464 (C.C.P.A. 1978) following the Supreme Court's decision in *Gottschalk v. Benson*, 409 U.S. 63 (1972). It was later modified in *In re Walter*, 205 U.S.P.Q. 397 (C.C.P.A. 1980), after the Supreme Court's decision in *Parker v. Flook*, 437 U.S. 584 (1978). It was again modified in *In re Abele*, 214 U.S.P.Q. 682 (C.C.P.A. 1982) after the Supreme Court's decision in *Diamond v. Diehr*, 450 U.S. 175 (1981). *See infra* note 77 for a description of the test.

71. According to the Supreme Court, "any" invention or discovery that fits within the categories of "process, machine, manufacture, or composition of matter" qualifies for patent protection with regard to section 101. Grammatically the term "any" is an expansive modifier which widens the scope of the included categories. *See* Diamond v. Chakrabarty, 447 U.S. 303, 308-9 (1980).

72. The Supreme Court in *Diamond v. Diehr* expressly stated that the term algorithm "is subject to a variety of definitions." Diamond v. Diehr, 450 U.S. 175, 186 n.9 (1981).

73. It is well settled law that "laws of nature, natural phenomena, and abstract ideas" are excluded from patent protection under 35 U.S.C. § 101. Diamond v. Diehr, 450 U.S. at 185.

74. *In re* Schrader, 30 U.S.P.Q.2d 1455, 1457 (Fed. Cir. 1994) (citing Arrhythmia Research Technology, Inc. v. Corazonix Corp., 22 U.S.P.Q.2d 1033, 1037 (Fed. Cir. 1992)).

Corazonix Corporation,[75] determined that the second inquiry was whether the mathematical algorithm is applied in any specific manner to process steps to precipitate a tangible use of the mathematical algorithm.[76] If it is specifically applied, the subject matter is statutory under section 101. If it is not applied, the mathematical algorithm amounts to an unpatentable abstract idea.[77]

The *Warmerdam* court appropriately choose not to apply the *Freeman-Walter-Abele* test to the invention at bar.[78] The court recognized that the test is difficult to implement for two reasons. First, it employs language that deviates from the patent statute.[79] Second, exactly what constitutes a "mathematical algorithm" remains unclear.[80] While the court's observation is accurate, the *Freeman-Walter-Abele* test is more problematic than the opinion conveys. As suggested by the court, the test should be replaced with a more workable method of detecting unpatentable subject matter. This conclusion is supported by two reasons which the court did not discuss. First, the test's initial determination is irrelevant because an algorithm that is not specifically applied in a claimed invention is an unpatentable abstract idea whether or not it is mathematical. Second, even when it is clear that the claimed invention does recite a mathematical algorithm, the test does not define what it means to "apply" a mathematical algorithm in the second step.

The first step of the *Freeman-Walter-Abele* test does not advance the statutory subject matter determination because an unapplied algorithm

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75. Arrhythmia Research Technology, Inc. v. Corazonix Corp., 22 U.S.P.Q.2d 1033 (Fed. Cir. 1992) (holding that a method and apparatus applied a computer algorithm to an electrocardiograph signal to detect a certain heart condition was patentable under the *Freeman-Walter-Abele* analysis.)

76. *Id.* at 1037.

77. *Id.* The actual wording of the *Freeman-Walter-Abele* test as recited by the *Arrhythmia* court is as follows:

It is first determined whether a mathematical algorithm is recited directly or indirectly in the claim. If so, it is next determined whether the claimed invention as a whole is no more than the algorithm itself; that is, whether the claim is directed to a mathematical algorithm that is not applied to or limited by physical elements or process steps. Such claims are nonstatutory. However, when the mathematical algorithm is applied in one or more steps of an otherwise statutory process claim, or one or more elements of an otherwise statutory apparatus claim, the requirements of section 101 are met.

Id.

78. *Warmerdam*, 31 U.S.P.Q.2d at 1758.

79. The term "mathematical algorithm" is not present anywhere in the 1952 Patent Act, 35 U.S.C. §§1-376. Judge Rader remarked that "[w]ithout a statutory anchor, this term was buffeted by every judicial wind until its course was indiscernible." Arrhythmia Research Technology, Inc. v. Corazonix Corporation, 22 U.S.P.Q.2d 1033, 1041 (Fed. Cir. 1992) (Rader, J., concurring).

80. *Warmerdam*, 31 U.S.P.Q.2d at 1758.

is unpatentable independent of its mathematical nature.[81] An unapplied mathematical algorithm, like an "abstract idea," is not patentable because it has not been made useful[82] as required by section 101.[83] Similar to a natural language, mathematics[84] can be thought of as means of expression.[85] Simply because a particular algorithm cannot be easily expressed in the language of mathematics does not mean it should escape scrutiny to determine if it is an unapplied, and thus, an unpatentable abstract idea.

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81. In the recent *Alappat* in banc opinion the Federal Circuit observed that in making the section 101 statutory determination, with regard to the first step of the *Freeman-Walter-Abele* test, that it is:

> not necessary to determine whether a claim contains, as merely a part of the whole, any mathematical subject matter which standing alone would not be entitled to patent protection. Indeed, because the dispositive inquiry is whether the claim as a whole is directed to statutory subject matter, it is irrelevant that a claim may contain, as part of the whole, subject matter which would not be patentable by itself.

In re Alappat, 31 U.S.P.Q.2d 1545, 1557 (Fed. Cir. 1994). In a related footnote the court states that applying the first step of the test, for example "attempt[ing] to identify . . . mathematical subject matter[,] is not an improper analysis." *Id.* at 1557 n.21. This damage control statement is false. Since the whole point of the first inquiry is to end the analysis if a mathematical algorithm is not directly or indirectly recited, the inclusion of this part of the test can result in improperly bypassing the critical query examined in the test's second part.

82. "[A]ny new and *useful* process, machine, manufacture, or composition . . . may obtain . . . patent" protection. 35 U.S.C. § 101 (1994) (emphasis added). The presence of term "new" is not interpreted as a requirement to satisfy § 101, while the term "useful" is part of the § 101 hurdle. *See generally* DONALD S. CHISUM, UNDERSTANDING INTELLECTUAL PROPERTY LAW § 2C[1] (1992) (discussing utility patents).

83. Arrhythmia Research Technology, Inc. v. Corazonix Corp., 22 U.S.P.Q.2d 1033, 1036 (Fed. Cir. 1992) (citing Diamond v. Diehr, 450 U.S. 175, 188 (1981)).

The usefulness of unapplied mathematical algorithms has been addressed in a recent scholarly article:

> Some will argue that a naked mathematical equation which is not tied to anything physical is useful because it may be used for research to possibly develop other mathematical algorithms which might ultimately be tied to something physical. However, the patent laws do not contemplate "potential" or "future" inventions. Rather, the patent laws protect useful inventions, i.e., useful at the time of the request for a patent. Thus, a mathematical algorithm which is abstract is also properly unpatentable.

Irah H. Donner, *Throwing Out Baby Benson With The Bath Water: Proposing A New Test For Determining Statutory Subject Matter*, 33 JURIMETRICS J. 247, 252 (1993).

84. Mathematics is defined as "the science of numbers and their operations, interrelations, combinations, generalizations, and abstractions and of space configurations and their structure, measurement transformations, and generalizations." MERRIAM WEBSTER'S COLLEGIATE DICTIONARY 717 (10th ed. 1993).

85. Arrhythmia Research Technology, Inc. v. Corazonix Corp., 22 U.S.P.Q.2d 1033, 1041 n.2 (Fed. Cir. 1992) (Rader, J., concurring). In the words of Judge Rader: "Mathematics, like a language, is a form of expression. The operation of a machine, the generation of electricity, the reaction of two chemicals, a baseball batter's swing, a satellite's orbit — all are within the descriptive power of mathematics." *Id.*

Application of the current *Freeman-Walter-Abele* test to the invention in *In re Freeman*[86] itself exposes the defect underlying the test's first step. The *Freeman* invention amounted to the calculation of a data structure to spatially relate characters in a typesetter control system. Despite this calculation, the *Freeman* court failed to recognize that appellant's invention directly recites a mathematical algorithm.[87] Thus, the mathematical algorithm was deemed patentable without considering whether it was sufficiently applied to be considered useful.[88]

Likewise, if the *Warmerdam* court had attempted to apply the *Freeman-Walter-Abele* test to the claimed invention, the critical second step might have been bypassed. Similar to *Freeman*, the claimed invention describes the creation of a data structure to spatially relate objects in a collision avoidance control system. Following the *Freeman* analysis, the process steps of the first claim do not constitute "solving a given type of mathematical problem."[89] Despite the apparent absence of a mathematical algorithm, the claimed invention still needs to be evaluated to determine whether the algorithm is applied in any manner. Dismissing a claimed invention without making this determination would improperly defeat the judicial exclusion of "abstract ideas."

The second step of the *Freeman-Walter-Abele* test is problematic because it does not indicate what constitutes a sufficiently specific application of an algorithm to convert a mere abstraction to a useful invention. Over the past twenty-two years, the Supreme Court, the Court of Customs and Patent Appeals, and the Federal Circuit have developed a spectrum of different standards from which to choose.

The Supreme Court in *Gottschalk v. Benson*[90] articulated the origi-

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86. *In re* Freeman, 197 U.S.P.Q. 464 (C.C.P.A. 1978).

87. *Id.* at 471. The *Freeman* court determined that the term algorithm had to be interpreted narrowly to mean "a procedure for solving a given type of mathematical problem." The court limited the meaning to a mathematical algorithm because a broad definition would be synonymous with term process. The court explained that accepting a broad definition would result in the "process" category of patentable subject matter being read out of the patent statute. *Id.*

88. P. Samuelson, *Benson Revisited: The Case Against Patent Protection for Algorithms and Other Computer Program-Related Inventions*, 39 EMORY L.J. 1025, 1154 (1990). In her article, Professor Samuelson explains:

> The *Freeman* case is one of a number of CCPA cases that misconstrues the nature of the invention being claimed. Freeman's invention did involve a mathematical problem, not because the items to be typeset were mathematical equations, but because the concatenation points, the hierarchical tree for noting positions, and the positioning algorithm were mathematical in character. However, the only thing the CCPA focused on in the *Freeman* claim was a typesetting process.

Id.

89. *Freeman*, 197 U.S.P.Q. at 471 (quoting the Supreme Court in Gottschalk v. Benson, 409 U.S. 63, 65 (1972)).

90. Gottschalk v. Benson, 409 U.S. 63 (1972). In *Benson*, the Court held that a method for converting binary coded decimal numbers into pure binary numbers was too much of an

nal standard for determining what constitutes the application of an abstract idea. The Court looked at several factors to determine if appellant's algorithm was applied. These factors included whether the claims were (1) tied to any particular art or technology, (2) tied to any particular apparatus or machinery, (3) tied to any particular end-use, or (4) whether they transformed "articles or materials to a different state or thing."[91] Thus, it can be deduced that process claims which satisfy at least some of the factors identified in *Benson* would constitute sufficient application of an algorithm to impart patentability.

Consideration of these factors lead the court in *In re Bradley*,[92] to state that claims that operate on, or are limited to, structural hardware elements fall literally within the boundaries of section 101.[93] In contrast, the court in *Arrhythmia* looked for a physical transformation and for the parameters of the claimed algorithm to be representative of some-

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abstraction to be patentable under section 101. *Id.* Binary code decimal (BCD) number is defined as:

> [a]ny number, usually consisting of successive groups of figures, in which each group of four figures is a binary number that represents, but does not necessarily equal arithmetically, a particular figure in an associated decimal number; for example, the decimal number 264 is represented as the binary coded number 0010 0110 0100.

WEBSTER'S NEW WORLD DICTIONARY OF COMPUTER TERMS 50 (5th ed. 1994). Binary is defined as "a mathematical representation of a number to the base 2, i.e., with only two states: 1 and 0, ON and OFF, or HIGH and LOW. It requires a greater number of digits than base 10; for example, 254 = 11111110." WEBSTER'S NEW WORLD DICTIONARY OF COMPUTER TERMS 49 (5th ed. 1994).

The Court described the claimed process as an abstract idea that a human could think through in making the conversion on paper: "The method sought to be patented varies the ordinary arithmetic steps a human would use by changing the order of steps, changing the symbolism for writing the multiplier used in some steps, and by taking subtotals after each successive operation." Gottschalk v. Benson, 409 U.S. 63, 67 (1972). Justice Douglas characterized the algorithm as a "generalized formulation for programs to solve mathematical problems." *Id.* at 65. The Court denied patent protection because "[t]he claims were not limited to any particular art or technology, to any particular apparatus or machinery, or to any particular end-use." *Id.* at 64. The Court also stated that "[t]he mathematical formula involved here has no substantial practical application except in connection with a digital computer." *Id.* at 72. Nor did they "operate to change articles or materials 'to a different state or thing.'" *Id.* at 71 (citing Cochrane v. Deener, 94 U.S. 780, 787-788 (1877)). However, the Court explicitly stated that its decision did not preclude the patentability of all software. The Court also stated that the issue of whether such programs should be patentable would be best addressed by Congress. *Id.* at 73.

91. *Benson*, 409 U.S. at 71.

92. *In re* Bradley, 202 U.S.P.Q. 480 (C.C.P.A. 1979), *cert. granted sub nom.* Diamond v. Bradley, 48 U.S.L.W. 3602 (1980).

93. *Id.* at 485. In *Bradley*, the court held that a data structure implemented in firmware and used to maintain memory integrity in a cache system, constituted statutory subject matter. The court reasoned that since the data structure which defined the appellants algorithm recited sufficient physical structure it was not an unapplied abstract idea. *Id.*

thing tangible.[94] In *re Abele*,[95] the fifth and sixth claims of the application were in question.[96] Claim 5 was a method for calculating and displaying data.[97] Claim 6 was a method for calculating and displaying X-ray attenuation data.[98] In rejecting claim 5 and accepting claim 6, the court indicated that section 101 only required the parameters of the algorithm to represent a value that had some specific real-world significance.[99]

Significantly, the Federal Circuit in the recent in banc decision, *In re Alappat*,[100] did not apply the *Freeman-Walter-Abele* test. Alappat claimed an apparatus, which employed an algorithm, for more accurately representing a waveform on a discrete pixel display.[101] The invention could be implemented in software or hardware. The *Alappat* court explained that "the proper inquiry in dealing with the so called mathematical subject matter exception to § 101 . . . is to see whether the claimed

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94. Arrhythmia Research Tech., Inc. v. Corazonix Corp., 22 U.S.P.Q.2d 1033 (Fed. Cir. 1992). In *Arrhythmia*, the Federal Circuit examined the patentability of a computer algorithm used to analyze an electrocardiograph signal. The patent at issue recited a process for analyzing a waveform. The first claim is exemplary of the method claims:

1. A method for analyzing electrocardiograph signals to determine the presence or absence of a predetermined level of high frequency energy in the late QRS signal, comprising the steps of:

[a] converting a series of QRS signals to time segments, each segment having a digital value equivalent to the analog value of said signals at said time;

[b] applying a portion of said time segments in reverse time order to high pass filter means;

[c] determining an arithmetic value of the amplitude of the output of said filter; and

[d] comparing said value with said predetermined value.

Id.

The court held that the claims recited patentable subject matter. In applying the second step of the *Freeman-Walter-Abele* test, the *Arrhythmia* court interpreted the second part to be an inquiry into whether the parameters of the algorithm relate to anything tangible. Citing *Benson*, Corazonix argued that the claims defined nothing more than a mathematical algorithm that calculates numbers. Judge Newman held that the number produced was not a mathematical abstraction, but a physical measure in microvolts of specific heart activity. She explained that the claimed steps of "converting," "applying," "determining," and "comparing" were sufficiently physical because they transformed one physical electrical signal into another. She reasoned that since signals were physical, their manipulation constituted a patentable process. Despite the fact that the claimed algorithm could be expressed in the abstract and the end result was a numerical representation, by application to electrocardiograph analysis, the process became patentable.

95. *In re* Abele, 214 U.S.P.Q. 682 (C.C.P.A. 1982).

96. *Id.* at 687.

97. *Id.* at 687-88.

98. *Id.*

99. *Id.*

100. *In re* Alappat, 31 U.S.P.Q.2d 1545 (Fed. Cir. 1994).

101. *Id.* at 1552.

subject matter is a disembodied mathematical concept."[102] The court held that Aiappat's apparatus, called a "rasterizer,"[103] was patentable subject matter because it was "a specific machine to produce a useful, concrete, and tangible result."[104]

Thus, the principle defect with the second part of the *Freeman-Walter-Abele* test is that the court is unable to define what it means to apply an algorithm. Given the inadequacy of the *Freeman-Walter-Abele* test, it is becoming clear a more useable test is needed.

B. CLASSIFICATION OF THE *WARMERDAM* CLAIMS

The *Warmerdam* court attempted to return to the language of the statute and the Supreme Court's decision in *Diehr* to determine whether Warmerdam's invention as claimed was too abstract to merit patent protection.[105] Following the recent trend in the Federal Circuit,[106] the *Warmerdam* court focused its analysis on the "abstract idea" exclusion to patentable subject matter. Unfortunately, the process claims were inaccurately analogized to an abstract idea without considering a sufficient number of other, more analogous statutory inventions. The court failed to determine just how abstract Warmerdam's invention was relative to the inventions of prior case law.

The *Warmerdam* court erred in affirming the Board's rejection of claims 1-4. The court incorrectly characterized Warmerdam's claimed process invention as unpatentable because it was merely the "manipulation of abstract ideas."[107] Process claims that apply mathematical abstractions to real-world, physical measurements in order to calculate results that relate directly to tangible subject matter satisfy section 101.[108] In *Arrhythmia*, the court reasoned that to determine whether

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102. *Id.* at 1558.

103. "Rasterization" is "[t]he conversion of vector graphics to equivalent images composed of pixel patterns (bit-mapped images)." WEBSTER'S NEW WORLD DICTIONARY OF COMPUTER TERMS 481 (5th ed. 1994).

104. *Alappat*, 31 U.S.P.Q.2d at 1558.

105. *In re* Warmerdam, 31 U.S.P.Q. 1754 (Fed. Cir. 1994).

106. *See* Arrhythmia Research Technology, Inc. v. Corazonix Corp., 22 U.S.P.Q.2d 1033, 1038 (Fed. Cir. 1992) (finding that output signals representative of a heart condition were sufficiently "physical" to impart section 101 patentability to the appellant's invention); *In re* Schrader, 30 U.S.P.2d 1455, 1458 (Fed. Cir. 1994) (holding that there was "nothing physical about [the appellant's method for bidding on a plurality of related items] per se" and thus the claimed invention did not pass section 101 muster); and *In re* Alappat, 31 U.S.P.Q.2d at 1558 (holding that the appellant's means for displaying a smooth line on a pixel display was "not a disembodied mathematical concept which may be characterized as an 'abstract idea,' but rather a specific machine to produce a useful, concrete, and tangible result").

107. *Warmerdam*, 31 U.S.P.Q.2d at 1758.

108. *Arrhythmia*, 22 U.S.P.Q.2d at 1037.

section 101 is satisfied, the central question to be evaluated is "what do the method steps accomplish?" rather than "how are the steps performed?"[109] Thus, claims to a process that implements a mathematical abstraction to achieve tangible results are more than abstract ideas and do satisfy section 101.[110] The *Warmerdam* court's equating "abstract ideas" with "the manipulation of abstract ideas" indicates that the court improperly focused on "how" the process works rather than on "what" the process does. The *Warmerdam* court failed to consider the process invention's relationship to the real world. Warmerdam's process defines the physical contours of a tangible object so that a motion control machine can move the object without crashing into other objects. As in *Arrhythmia*, the data manipulated by the process has tangible meaning in the real world. Thus, the process is more than an abstract idea and should be patentable.

` It is unclear from the opinion whether the court in *Warmerdam* understood that the parameters of the algorithm claimed in the '749 application actually represented physical dimensions of physical objects. Because the court repeatedly stated that the process amounted to nothing more than "manipulations of abstract ideas" without further explanation, it is evident the court assumed that the data structure did not necessarily represent tangible objects. Such an assumption is false for two reasons. First, the "bubbles" in fact define safety zones about a physical object. Second, the actual variables used in the calculations, (e.g., bubble radii, distances between the centers of bubbles, etc.) are directly related to the physical dimensions of the physical object.

Finally, acknowledgment of the "obvious correctness" of allowing claim 5 simply because it is phrased as an apparatus claim, further betrays the flawed reasoning of the court. Assuming the court is not "exalting form over function,"[111] the apparatus of claim 5 should be patentable not just because it is a machine, but also because the data "manipulations" that it affects to create a data structure are not a mathematical abstraction. This was the holding of *Alappat*. If a machine or its use "would define an invention under section 101 then the same invention described in terms of a mathematical formula, computer program, or digital computer should be statutory subject matter as well."[112] The data structure is in fact representative of the physical shape and position of a tangible object.

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109. *Id.*

110. *Id.*

111. *In re* Alappat, 31 U.S.P.Q.2d 1545 (Fed. Cir. 1994).

112. *Id.*

C. DEFINING THE ABSTRACTNESS CONTINUUM

Looking at the major decisions discussed above, it is evident that it is difficult to predict when the court will find a claim to a software implemented process to be non-statutory. However, recalling that the court's underlying concern is "to promote the Progress of Science and the useful Arts"[113] by not granting or enforcing patents for unapplied and thus not "useful" abstract ideas, helps to discern a pattern to the precedent.[114] The degree of abstractness is the common thread that runs through the myriad of considerations and tests that the courts have applied to determine patentability of software implemented processes.[115] By analyzing the degree of abstractness of a claimed invention based on precedent, one can determine whether a software implemented process will be deemed sufficiently applied to merit protection.

Since the *Benson* decision, the courts have used many different tests in various combinations to make the ultimate determination of whether a claim fits within section 101.[116] The fact specific considerations, the technical complexities of the inventions, the inapplicability or over-broadness of some of the tests, and various other problems have contributed to making this ultimate determination very difficult. However, by considering the principle tests of patentability as mere indicia of abstractness, the precedent claims can be arrayed along a continuum. The continuum ranges from a tangibly useful process to an unapplied abstract principle. Once the precedent claims have been plotted and the

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113. U.S. CONST. art. I, §8, cl. 8.

114. *See* Irah H. Donner, *Throwing Out Baby Benson With The Bath Water: Proposing A New Test For Determining Statutory Subject Matter*, 33 JURIMETRICS J. 247, 252 (1993). Mr. Donner explains that "[a]bstract ideas are . . . not patentable since section 101 requires that the invention be 'useful.' 'Abstract' is defined as '[c]onsidered apart from any application to a particular object; . . . used without reference to a thing or things; —said of a unit number, 10. Opposite of concrete unit or number; as 1 foot, 10 men.'" *Id.*
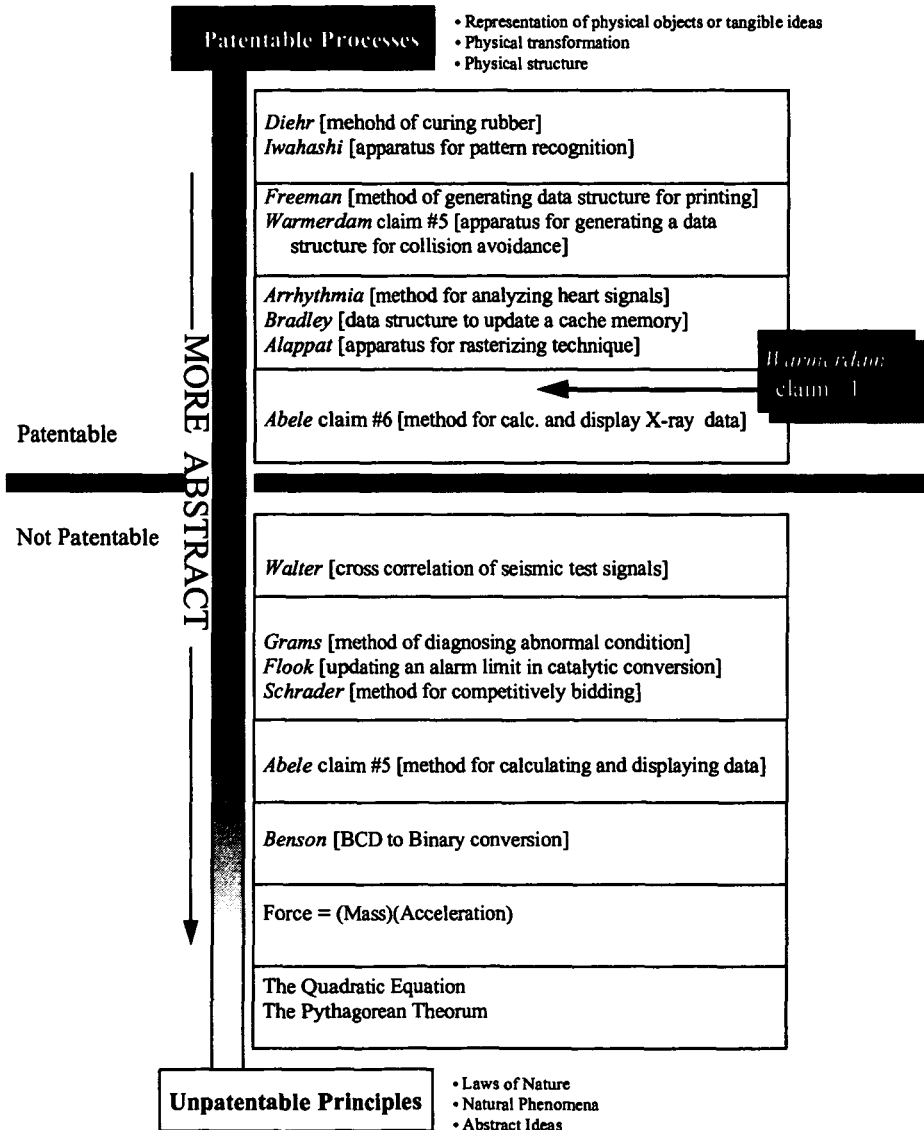
115. *See* Gregory A. Stobbs, *The Common Thread Unraveled*, THE LAW WORKS, May 1995, at 6. Mr. Stobbs theorized that "human control" might be the common thread that runs through all of the patentable subject matter cases. He suggests that if human control is exerted over the abstract ideas contained in an invention as claimed, the subject matter will be held patentable. Derived from the concept of possession of real property, this interesting idea has not been articulated or applied by a court in a patent case. However, application to precedent claims seems to indicate that Mr. Stobbs has at least detected an unconscious consideration of the courts.

116. *See* Lee E. Barrett, *Patentable Subject Matter: Mathematical Algorithms and Computer Programs*, 1106 OFF. GAZ. T.M. OFFICE 5 (1989). Mr. Barrett, an Associate Solicitor in the Office of the Solicitor of the PTO, enumerates several considerations of the courts in determining whether a mathematical algorithm is "applied in any manner to physical elements or process steps: (a) Post-solution activity, (b) Field of use limitations, (c) Data-gathering steps, (d) Transformation of something physical, and (e) Structural limitations in process claims." *Id.*

patentability line has been drawn, the resulting continuum of abstract-ness is useful to gauge the patentability of other inventions.

The following chart depicts such an abstractness continuum with the various inventions from the precedent case law represented. The claims of the inventions become more abstract going from top to bottom.

THE ABSTRACTNESS CONTINUUM

Patentable Processes
- Representation of physical objects or tangible ideas
- Physical transformation
- Physical structure

Diehr [mehohd of curing rubber]
Iwahashi [apparatus for pattern recognition]

Freeman [method of generating data structure for printing]
Warmerdam claim #5 [apparatus for generating a data structure for collision avoidance]

Arrhythmia [method for analyzing heart signals]
Bradley [data structure to update a cache memory]
Alappat [apparatus for rasterizing technique]

Warmerdam claim 1

Abele claim #6 [method for calc. and display X-ray data]

Patentable

MORE ABSTRACT

Not Patentable

Walter [cross correlation of seismic test signals]

Grams [method of diagnosing abnormal condition]
Flook [updating an alarm limit in catalytic conversion]
Schrader [method for competitively bidding]

Abele claim #5 [method for calculating and displaying data]

Benson [BCD to Binary conversion]

Force = (Mass)(Acceleration)

The Quadratic Equation
The Pythagorean Theorum

Unpatentable Principles
- Laws of Nature
- Natural Phenomena
- Abstract Ideas

As the above diagram indicates, the patentability of software implemented processes diminishes as the abstractness of the claims increase. The more the indica suggest that claims are not limited to a specific implementation of the abstract principle involved, the more abstract the claims. The indicia of abstractness considered to determine the relative positions of the precedent claims include:

(a) the degree to which the parameters of the abstract principles or mathematical algorithms contained in the claim represents physical, tangible ideas;

(b) if the claim does not integrally include the performance of a function based upon the results of applying the abstract principles;

(c) if the claim does not include the transformation of physical objects;

(d) if the claim does not include the transformation of data representative of physical objects;

(e) if the claim does not include explicit or implicit structural limitations;

(f) if the claim does not limit the application of the abstract principle to a particular field of technology;

(g) the extent to which apparent limitations in the claim's preamble are required by elements contained in the body of the claim;

(h) if the claim as whole only determines the solution to a problem in abstract terms that lack real world significance; and

(i) if the claim does not permit or require the exertion of human control over the abstract principles being applied.[117]

At the clearly patentable end of the continuum are claims, limited to a particular technology and a specified apparatus, in which an abstract relationship between tangible ideas have been applied to alter physical matter. For example, in *Diamond v. Diehr*,[118] a method of molding rubber using a computer calculated cure time was held patentable. The pro-

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117. *See supra* note 115.
118. Diamond v. Diehr, 450 U.S. 175, 181 n.5 (1981). The *Diehr* claim reads:
   11. A method of manufacturing precision molded articles from selected synthetic rubber compounds in an openable rubber molding press having at least one heated precision mold, comprising:
      (a) heating said mold to a temperature range approximating a pre-determined rubber curing temperature,
      (b) installing prepared unmolded synthetic rubber of a known compound in a molding cavity of predetermined geometry as defined by said mold,
      (c) closing said press to mold said rubber to occupy said cavity in conformance with the contour of said mold and to cure said rubber by transfer of heat thereto from said mold,
      (d) initiating an interval timer upon the closure of said press for monitoring the elapsed time of said closure,
      (e) heating said mold during said closure to maintain the temperature thereof within said range approximating said rubber curing temperature,

cess used a molding press apparatus and the Arrhenius equation to relate the tangible ideas of time, energy, temperature, and the mold's geometry to transform rubber from an uncured state to a cured state. Likewise, in *In re Iwahashi*,[119] an apparatus described in "means plus function" language was held patentable. The device implemented an algorithm in a specific manner to define relationships between the claim's physical elements. The claim in question recited a read only memory as well as functions that necessarily require the generation and alteration of electrical signals. The court noted that the preamble specified that the apparatus was for use in a pattern recognition system.

(f) constantly determining the temperature of said mold at a location closely adjacent said cavity thereof throughout closure of said press,

(g) repetitively calculating at frequent periodic intervals throughout closure of said press the Arrhenius equation for reaction time of said rubber to determine total required cure time v as follows: ln v = cz + x wherein c is an activation energy constant determined for said rubber being molded and cured in said press, z is the temperature of said mold at the time of each calculation of said Arrhenius equation, and x is a constant which is a function of said predetermined geometry of said mold,

(h) for each repetition of calculation of said Arrhenius equation herein comparing the resultant calculated total required cure time with the monitored elapsed time measured by said interval timer,

(i) opening said press when a said comparison of calculated total required cure time and monitored elapsed time indicates equivalence, and

(j) removing from said mold the resultant precision molded and cured rubber article.

Id.

119. *In re* Iwahashi, 888 F.2d 1370, 1372, 12 U.S.P.Q. 1908, 1909 (Fed. Cir. 1989). The *Iwahashi* claim is in "means plus function format" and thus, is read as an apparatus claim. The claim reads:

An auto-correlation unit for providing auto-correlation coefficients for use as feature parameters in pattern recognition for N pieces of sampled input values X_n(n=0 to N-1), said unit comprising:

means for extracting N pieces of sample input values X_n from a series of sample values in an input pattern expressed with an accuracy of optional multi-bits;

means for calculating the sum of the sample values X_n and X_{n-r}(t=0-P, P<=N);

a read only memory associated with said means for calculating;

means for feeding to said read only memory the sum of the sampled input values as an address signal;

means for storing in said read only memory the squared value of each sum, $(X_n + X_{n-r})^2$

means for fetching and outputting the squared values of each such sum of the sample input values from said read only memory when said memory is addressed by the sum of the sample input values; and

means responsive to the output $(X_n+X_{n-r})^2$ of said read only memory for providing an auto-correlation coefficient for use as a feature parameter according to the following formula:

$$\sum_{n=0}^{N-1} \frac{(X_n+X_{n-r})^2}{2*\sum_{n=0}^{N-1} X_n^2} - 1$$

Id.

Moving along the continuum, the next category includes claims that are limited to specific apparatus, and to applications within a particular field of technology, that use a relationship between tangible ideas to generate a representation of a tangible idea. Such claims have been held sufficiently "applied" to be patentable. For example, in *In re Freeman*,[120] a method for generating a data structure for printing equations was held patentable. The court's analysis is not helpful in determining the relative abstractness of the method claims. This is because it fell into the trap of looking for an explicit mathematical algorithm and upon not detecting one, determined that the claims "merely define a new, useful, and unobvious process for operating a computer display system"[121] and thus, must be patentable. However, a fresh look at the process described in claim 8 reveals that the invention is explicitly limited to a general purpose computer and display. While it seems this indicia alone has sometimes been sufficient to hold claims patentable, there is a better reason to find that *Freeman* claim 8 is not merely an abstraction. The parameters of the algorithm involved are the physical positions of concatenation points of images. The process determines the proper location of the various images relative to each other based on the concatenation points. Thus, data that represents the images and their relative positioning are translated into data useful for properly displaying the image. Based on the same reasoning, Claim 5 of *Warmerdam* falls into this level of abstractness. Claim 5, an apparatus for generating a data structure for a

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120. *In re Freeman*, 573 F.2d 1237, 1249, 197 U.S.P.Q. 464, 468 (C.C.P.A. 1978). Claim 8 in *Freeman* is a method claim:

    8. In a computer display system comprising
        (A) a display device for generating relatively-positioned symbol images in response to applied sequences of signals specifying the shape and position of said images,
        (B) a data processor comprising
            (1) means for storing a first plurality of data sequences, each describing individual symbols, and a second plurality of data sequences corresponding to a control program,
            (2) means responsive to said control program for nondestructively reading from said means for storing and transferring to said display device selected ones of said first plurality of data sequences,
            (3) control means comprising means responsive to said control program for generating and transferring to said display device data sequences specifying the desired position of symbols corresponding to said selected data sequences,
        the method of controlling said system comprising the steps of
        (A) generating data sequences corresponding to concatenation points associated with each of said symbol images, and
        (B) generating data sequences specifying that selected ones of said concatenation points associated with desirably adjacent symbol images should occupy identical spatial positions.

Id.

    121. *Id.* at 471.

collision avoidance motion control system,[122] was held patentable.

In the next step towards abstractness, the indicia of reciting the specific apparatus employed to execute the software process, is not present as a claim limitation. However, the claims still recite limitations that require the alteration of physical matter. For example, in *Arrhythmia*,[123] a method for analyzing electrocardiograph signals to detect a specific characteristic was held patentable. The alteration of electrical signals was deemed a transformation of a physical object. In *In re Bradley*,[124] a data structure used to update a cache memory was held patentable. In *Alappat*,[125] an apparatus for employing a rasterizing method was held patentable. In both *Bradley* and *Alappat*, the specification supported replacing the "means for . . ." language with specific apparatus.

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122. Warmerdam's fifth claim is for a machine containing the data structure. "5. A machine having a memory which contains data representing a bubble hierarchy generated by the method of any of Claims 1 through 4." *Id.* at 1757.

123. Arrhythmia Research Tech., Inc. v. Corazonix Corp., 22 U.S.P.Q.2d 1033, 1035 (Fed. Cir. 1992). The *Arrhythmia* claim reads:

    1. A method for analyzing electrocardiograph signals to determine the presence or absence of a predetermined level of high frequency energy in the late QRS signal, comprising the steps of:

        [a] converting a series of QRS signals to time segments, each segment having a digital value equipment to the analog value of said signals at said time;

        [b] applying a portion of said time segments in reverse time order to high pass filter means;

        [c] determining an arithmetic value of the amplitude of the output of said filter; and

        [d] comparing said value with said predetermined value.

Id.

124. *In re* Bradley, 600 F.2d 807, 810, 202 U.S.P.Q. 480, 482-3 (C.C.P.A. 1979). Claim 1 is representative of the appealed claims:

    1. In a multiprogramming computer system having a main memory, a central processing unit (CPU) coupled to said (CPU) controlling the state of a plurality of groups of processes being in a running, ready, wait or suspended state, said computer system also having scratchpad registers being accessible to an operating system for controlling said multiprogramming computer system, a data structure for storing coded signals for communicating between said processes and said operating system, and said scratchpad registers, said data structure comprising:

        (a) first means in said data structure and communicating with said operating system for storing coded signals indicative of an address for a selected one of said processes;

        (b) second means in said first means for storing coded signals indicating priority of said selected one of said processes in relation to others of said processes for obtaining control of said CPU when ready;

        (c) third means in said data structure and communicating with said operating system, for storing coded signals indicative of an address for a selected one of said plurality of groups of processes, and,

        (d) fourth means coupled to said data structure and said scratch pad registers, for generating signals causing the changing of information in said data structure and said scratchpad registers.

Id.

125. *In re* Alappat, 31 U.S.P.Q.2d 1545, 1553 (Fed. Cir. 1994).

The *Alappat* Claim 15, the only independent claim in issue, reads:

In the next step on the continuum, the transformation of physical objects indicia is not present. Instead, the claims include the transformation of data representative of physical objects. The main indicia that the claims are sufficiently applied is that a relationship between tangible ideas is applied to generate a representation of a tangible idea or physical object. For example, in *In re Abele*,[126] claim 6, a method for calculating and displaying X-ray attenuation data was held patentable. The claimed invention implicitly requires the measurement of X-ray attenuation. In distinguishing claim 5 from claim 6, the court did not give weight to the structural limitation of a "computed tomography scanner." Instead it focused on claim 6's restriction of "data" to "X-ray attenuation data."

In proceeding along the abstractness continuum it is at this point that the patentable/non-patentable line has been drawn by the courts. While some of the following precedent claims exhibit some indicia that they are not abstractions, the courts have held that they are indistinguishable from "laws of nature, natural phenomena, and abstract ideas."[127] In *In re Walter*,[128] a method of correlating seismic test signals to reference signals was held not patentable. The court stated that "a

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A rasterizer for converting vector list data representing sample magnitudes of an input waveform into anti-aliased pixel illumination intensity data to be displayed on a display means comprising:

(a) means for determining the vertical distance between the endpoints of each of the vectors in the data list;

(b) means for determining the elevation of a row of pixels that is spanned by the vector;

(c) means for normalizing the vertical distance and elevation; and

(d) means for outputting illumination intensity data as a predetermined function of the normalized vertical distance and elevation.

Id.

126. *In re* Abele, 684 F.2d 902, 214 U.S.P.Q. 687 (C.C.P.A. 1982). Claim 6 of *Abele* reads: "6. The method of claim 5 wherein said data is X-ray attenuation data produced in a two dimensional field by a computed tomography scanner." *Id. See supra* note 136 for Claim 5 of *Abele*.

127. *See supra* note 73.

128. *In re* Walter, 618 F.2d 758, 205 U.S.P.Q. 397 (C.C.P.A. 1980). The *Walter* claim reads:

7. In a method of seismic surveying in which a train of seismic source waves is transmitted downwardly into the earth and is there deflected by subsurface formations and in which corresponding trains of seismic waves deflected by such formation are received at geophone stations in a spread at the surface of the earth and wherein;

each train of received seismic waves is converted into a corresponding series of digital sample signals; and

a series of reference signals corresponding to sample of said transmitted seismic waves is developed;

the improved method of correlating said series of sample signals for each geophone station with respect to said series of reference signals that comprises

a) converting said series of sample signals into an augmented series of sample signals divided into N+1 segments of equal length thereby forming a series of se-

decision as to whether the invention utilizing . . . [a] truth [or abstract idea] is statutory must necessarily rest on the relationship which the truth or principle bears to the remainder of the substance of the invention as claimed."[129] Weighing on the side of patentability, claim 7 of *Walter* is limited to a particular technological environment and the abstract principle[130] employed allows one to relate reference signals to recorded signals that are representative of physical subsurface formations of the earth. However the court held that the invention as claimed does not generate a useful result. The process solves the math and presents the solution in abstract terms. In essence, the application of the math is not complete and thus, the abstract idea has not been made useful. The court indicated that if the process had produced or improved a representation of the subsurface formations, the claim would have been patentable.[131]

The next level of abstractness along the continuum is more straight forward. In *Parker v. Flook*,[132] a method for updating an alarm limit in

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quential segments Ssubi of said augmented series, including an empty end segment, where i=1, . . ., N+1;

b) forming a Fourier transform FTSsubi of each respective series of signals composed of pairs of successive segments Ssubi and Ssubi 1 of said augmented series, each said Fourier transform being represented by a first series of transform signals,

c) forming a combined segment of each segment Csubj of said reference signals and an empty segment of equal length, where j=1, . . . L, each said combined segment comprising a series of signals of double length, where
[a complex mathematical formula]

d) forming a corresponding Fourier transform FTCsubj of each said combined segment, each said latter Fourier transform being represented by a second series of transform signals,

e) forming the non-zero conjugate complex vector products of pairs of the respective Fourier transforms and adding them together in accordance with the following expression:
[a complex mathematical formula]

where N represents the number of segments in the series of reference signals, and
[a complex mathematical formula]

where M is the number of segments to be produced in the cross-correlated result, to produce a series of partial product signals FTPm where m = 1, 2 . . . M representative of the Fourier transform or said series of sample signals and said series of reference signals for each said geophone station.

Id. at 402.

129. *Id.* at 405.

130. The abstract principle in the *Walter* claim is known as the Cooley-Tukey algorithm as modified by Bergland. *Id.* at 402.

131. *Id.* at 407.

132. Parker v. Flook, 437 U.S. 584, 596-97, 198 U.S.P.Q. 193 (1978).

Claim 1 of the *Flook* patent describes a method as follows:

1. A method for updating the value of at least one alarm limit on at least one process variable involved in a process comprising the catalytic chemical conversion of hydrocarbons wherein said alarm limit has a current value of

Bo + K

the catalytic chemical conversion of hydrocarbons was held not patentable. At first blush, the inclusion of a limitation to the conversion of hydrocarbons within the disputed claim would indicate that the claim is not an abstraction. However, a closer look reveals that the *Flook* claim is not limited to a specific application of an abstract principle. The relationship of the parameters of the recited equation to the physical conversion process are not specified or even implicit in the claim. Each variable in the equation is defined in the claim but none of them are even indirectly representative of a tangible idea, physical object or physical effect.

In *In re Grams*,[133] a method of diagnosing an abnormal condition in an individual was held not patentable. Despite the fact that the claims were limited to the physical process of diagnosing an individual, claim 1 fails to specify what "parameters" the process would use. Thus, the variables used in the process are undefined and cannot be considered repre-

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wherein Bo is the current alarm base and K is a predetermined alarm offset which comprises:

(1) Determining the present value of said process variable, said present value being defined as PVL;
(2) Determining a new alarm base B sub1 , using the following equation:

$$B\ sub1\ =\ Bo(1.0\text{-}F)\ +\ PVL(F)$$

where F is a predetermined number greater than zero and less than 1.0;
(3) Determining an updated alarm limit which is defined as B sub1 + K; and thereafter
(4) Adjusting said alarm limit to said updated alarm limit value.

Id.

133. *In re Grams*, 12 U.S.P.Q. 1824, 1825 (Fed. Cir. 1989). The *Grams* claim reads:

1. A method of diagnosing an abnormal condition in an individual, the individual being characterized by a plurality of correlated parameters of a set of such parameters that is representative of the individual's condition, the parameters comprising data resulting from a plurality of clinical laboratory tests which measure the levels of chemical and biological constituents of the individual [sic] and each parameter having a reference range of values, the method comprising

[a] performing said plurality of clinical laboratory tests on the individual to measure the values of the set of parameters;
[b] producing from the set of measured parameter values and the reference ranges of values a first quantity representative of the condition of the individual;
[c] comparing the first quantity to a first predetermined value to determine whether the individual's condition is abnormal;
[d] upon determining from said comparing that the individual's condition is abnormal, successively testing a plurality of different combinations of the constituents of the individual by eliminating parameters from the set to form subsets corresponding to said combinations, producing for each subset a second quantity, and comparing said second quantity with a second predetermined value to detect a non-significant deviation from a normal condition; and
[e] identifying as a result of said testing a complementary subset of parameters corresponding to a combination of constituents responsible for the abnormal condition, said complementary subset comprising the parameters eliminated from the set so as to produce a subset having said non-significant deviation from a normal condition.

Id.

sentative of any tangible ideas or physical objects. Likewise, in *In re Schrader*,[134] a method for competitively bidding was held not patentable. The claim is abstract because the parameters of the process are defined to be abstractions.

Moving further away from patentability along the continuum, one finds that not only are the parameters of the abstract relationships not identified or defined but they are not even implicitly applied to a useful process[135] or limited to a particular technological environment. For example, in *In re Abele*,[136] claim 5, a method for calculating and displaying data, was held not patentable. The claim speaks of "data" in the same abstract way that the claim in Grams speaks of "parameters." Claim 5 of *Abele* is more abstract than the one found in *Grams* because here, the claim does not even imply what kind of data is being used.

Nearing the clearly abstract end of the continuum are claims in which there is absolutely no indication of a relationship between the claimed process and tangible ideas. For example, in *Gottschalk v. Benson*,[137] a method for converting BCD numerals to binary numerals was held not patentable. The claimed invention does transform signals from one form to another. In addition, claim 8 does contain a structural limi-

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134. *In re* Schrader, 30 U.S.P.Q.2d 1455, 1456 (Fed. Cir. 1994). The *Schrader* claim reads:

    1. A method of competitively bidding on a plurality of items comprising the steps of identifying a plurality of related items in a record, offering said plurality of items to a plurality of potential bidders, receiving bids from said bidders for both individual ones of said items and a plurality of groups of said items, each of said groups including one or more of said items, said items and groups being any number of all of said individual ones and all of the possible combinations of said items, entering said bids in said record, indexing each of said bids to one of said individual ones or said groups of said items, and assembling a completion of all said bids on said items and groups, said completion identifying a bid for all of said items at a prevailing total price, identifying in said record all of said bids corresponding to said prevailing total price.

Id.

135. *In re* Abele, 214 U.S.P.Q. 682, 688 (C.C.P.A. 1982).

136. *Id.* Claim 5 of the invention in *Abele* reads:

    5. A method of displaying data in a field comprising the steps of

        calculating the difference between the local value of the data at a data point in the field and the average value of the data in a region of the field which surrounds said point for each point in said field, and

        displaying the value of said difference as a signed gray scale at a point in a picture which corresponds to said data point.

Id.

137. Gottschalk, v. Benson, 409 U.S. 63, 175 U.S.P.Q. 673 (1962). Claim 8 of *Benson* reads:

    The method of converting signals from binary coded decimal form into binary which comprises the steps of

    (1) storing the binary coded decimal signals in a reentrant shift register,

    (2) shifting the signals to the right by at least three places, until there is a binary '1' in the second position of said register,

tation: a shift register. It can even be argued that the "signals" are limited to "electrical signals" based on the specification. However, the claims specify that the signals merely represent abstract numbers. The numbers are not related to any physical object or tangible idea. The process solves the math in general without applying it. Absent application of the process to the real word, the process is not "useful" and thus, too abstract to merit patent protection.

D.   LOCATING *WARMERDAM* ON THE CONTINUUM

The *Warmerdam* claims 1-4[138] recite a physical measurement step in that locating the medial axis of an object is analogous to measuring the height of a building. Measuring a twenty story building is most practically performed using calculations in combination with known dimensions rather than by dropping a tape measure down the side. A building is measured efficiently by measuring the height of one floor and multiplying the result by the number of stories in the building. Similarly, the medial axis of an object is calculated by performing mathematical operations on the known dimensions of the object.

Nevertheless, the court incorrectly equated this physical measure-

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(3) masking out said binary '1' in said second position of said register,

(4) adding a binary '1' to the first position of said register,

(5) shifting the signals to the left by two positions,

(6) adding a '1' to said first position, and

(7) shifting the signals to the right by at least three positions in preparation for a succeeding binary '1' in the second position of said register.

Claim 13 reads as follows:

A data processing method for converting binary coded decimal number representations into binary number representations comprising the steps of

(1) testing each binary digit position 'i,' beginning with the least significant binary digit position of the most significant decimal digit representation for a binary '0' or a binary '1;'

(2) if a binary '0' is detected, repeating step (1) for the next least significant binary digit position of said most significant decimal representation;

(3) if a binary '1' is detected, adding a binary '1' at the (i + 1)th and (i + 3)th least significant binary digit positions of the next lesser significant decimal digit representation, , and repeating step (1) for the next least significant binary digit position of said most significant decimal digit representation;

(4) upon exhausting the binary digit positions of said most significant decimal digit representation, repeating steps (1) through (3) for the next lesser significant decimal digit representation as modified by the previous execution of steps (1) through (3); and

(5) repeating steps (1) through (4) until the second least significant decimal representation has been so processed.

1 DONALD S. CHISUM, PATENTS §2C[1][f][ii](1) n.65 (1993).

138. Warmerdam's first claim describes a two step process for generating a data structure: "1. A method for generating a data structure which represents the shape of [sic] physical object in a position and/or motion control machine as a hierarchy of bubbles, comprising the steps of: first locating the medial axis of the object and then creating a hierarchy of bubbles on the medial axis." *Warmerdam*, 31 U.S.P.Q. at 1756.

ment step to the data gathering step of *In re Grams*.[139] The *Grams* claim did not identify tangible quantities to be monitored.[140] Thus, it was properly rejected because the data manipulated by the *Grams* algorithm did not necessarily represent anything in the physical world. In contrast, the *Warmerdam* "data-gathering" step involved the physical measurement of concrete objects.

The *Warmerdam* process step is analogous to the "X-ray data input step" of *Abele* claim 6. The *Abele* court properly recognized that such a step had real-world significance. Likewise, the *Warmerdam* court should have realized that the measurement of physical objects to avoid collisions is not an abstract idea. Therefore, the *Warmerdam* invention belongs alongside *Abele* claim 6 on the patentable side of the abstractness continuum.

VI. CONCLUSION

The *Warmerdam* court properly bypassed the *Freeman-Walter-Abele* test. However, the court incorrectly characterized Warmerdam's invention as being too abstract to be patentable. By comparing the degree of abstractness of the claims in *Warmerdam* to precedent claims, it is evident that prior cases have found other more abstract inventions patentable. Thus, based on relative abstractness, Warmerdam's claims should have passed section 101 muster.

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139. *In re* Grams, 888 F.2d 835 (Fed. Cir. 1989).
140. *See supra* note 133 for the *Grams* claim.