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(71) Applicant (for all designated States except US): **ENUVIS, INC.** [US/US]; ENUVIS, INC., 395 Oyster Point Boulevard, Suite 505, South San Francisco, CA 94080 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **SAHAI, Anant** [US/US]; 1501 Hillsdale Blvd., #107, San Mateo, CA 94402 (US). **TSITSIKLIS, John** [US/US]; 6 Dover Lane, Lexington, MA 02421 (US). **CASADEI, Stefano** [IT/US]; 1550 Bay Street, Apt. 337, San Francisco, CA 94123 (US). **CHOU, Andrew** [US/US]; 1501 Hillsdale Blvd., #211, San Mateo, CA 94402 (US). **VAN ROY, Benjamin** [US/US]; 1501 Hillsdale Blvd. #103, San Mateo, CA 94402 (US). **STONE, Jesse, R** [US/US]; 169 Waverley Street, Apt. D, Palo Alto, CA 94301 (US).

(74) Agent: **KWOK, Edward**; MacPherson, Kwok & Chen LLP, 2001 Gateway Place, Suite 195E, San Jose, CA 95110 (US).

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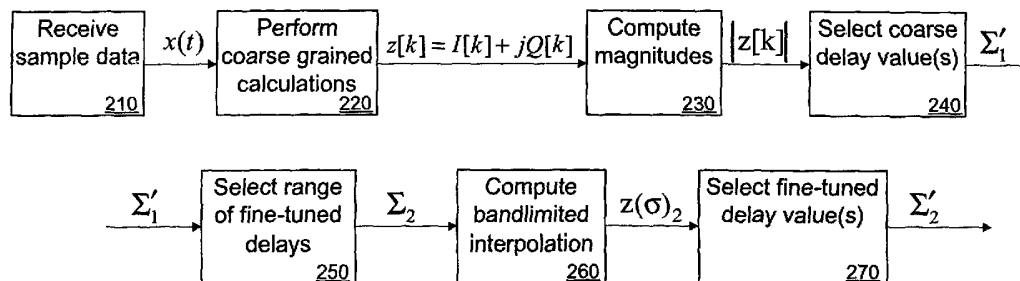
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Declarations under Rule 4.17:

— as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZM, ZW, ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent

[Continued on next page]

(54) Title: EXTRACTING FINE-TUNED ESTIMATES FROM CORRELATION FUNCTIONS EVALUATED AT A LIMITED NUMBER OF VALUES



(57) Abstract: Techniques are provided for fine-tuning estimates of a delay value for a sampled signal. One aspect of the invention is to perform, for the sampled signal, coarse-grained calculations of the In Phase and Quadrature (I and Q) correlation integrals at a limited number of points, wherein the calculations are performed over a range of hypothesized delay values. A range of delay values of interest are then determined from the coarse-grained calculations of the I and Q correlation integrals. A subset of I and Q values based on the coarse granularity calculations of the I and Q correlation functions is used to perform a time-domain interpolation to obtain fine-grained values of the I and Q integrals in the range of the delay values of interest. Magnitude calculations are performed based on the fine-grained values of the I and Q integrals. Fine-tuned estimates of delay value are based on the magnitude calculations. Alternatively, fine-tuned estimates of delay value are based on the template-matching approach.



(AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)

- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) for all designations

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 02/19964

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G01S5/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G01S H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EP0-Internal, WPI Data, PAJ, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	<p>US 4 578 678 A (HURD WILLIAM J) 25 March 1986 (1986-03-25)</p> <p>abstract; claim 2; figures 2,3 column 4, line 61 -column 5, line 27 column 9, line 53 - line 60 column 5, line 63 -column 6, line 35 --- -/--</p>	<p>1,2,5, 10,14, 18,19, 21,24, 28, 32-34,36</p>

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

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Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Niemeijer, R

INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 02/19964

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	<p>US 6 134 286 A (CHENNAKESHU SANDEEP ET AL) 17 October 2000 (2000-10-17)</p> <p>abstract; figures 1,3,4 column 3, line 27 -column 4, line 27 column 5, line 27 -column 7, line 17 ---</p>	<p>1,2,5, 14,18, 19,21, 25,28, 32-34,36</p>
X	<p>US 5 276 706 A (CRITCHLOW DAVID N) 4 January 1994 (1994-01-04)</p> <p>abstract; figures 4,5,7 column 5, line 9 - line 56 column 7, line 67 -column 8, line 46 column 10, line 22 - line 67 ---</p>	<p>18,19, 21,22, 28, 32-34, 36,37</p>
X	<p>US 6 219 345 B1 (CLARK RICKE W ET AL) 17 April 2001 (2001-04-17) abstract; claim 1; figure 4 column 3, line 16 - line 22 column 3, line 63 -column 5, line 32 -----</p>	<p>1,2,5, 11,14</p>

INTERNATIONAL SEARCH REPORT

international application No.
PCT/US 02/19964

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-14, 18-28, 32-38

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-14, 18-28, 32-38

Interpolation

2. Claims: 15-17, 29-31, 39-41

Template matching

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 02/19964

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 4578678	A	25-03-1986	NONE	
US 6134286	A	17-10-2000	AU 751774 B2 AU 9576498 A BR 9812914 A CA 2306917 A1 CN 1282479 T EP 1023798 A1 JP 2001520484 T WO 9920023 A1	29-08-2002 03-05-1999 08-08-2000 22-04-1999 31-01-2001 02-08-2000 30-10-2001 22-04-1999
US 5276706	A	04-01-1994	NONE	
US 6219345	B1	17-04-2001	NONE	