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Published:
— with international search report

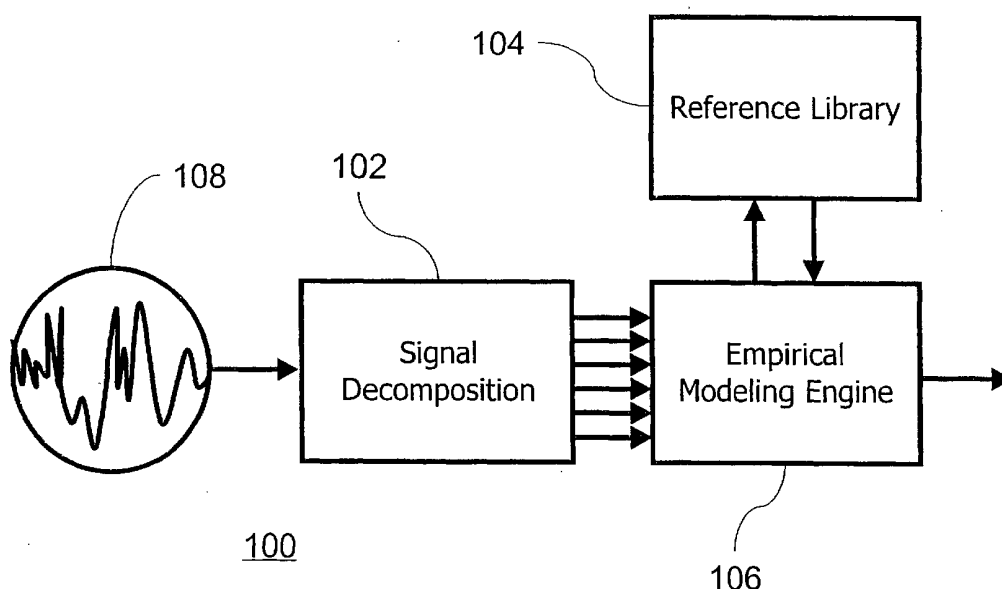
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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: **COMPLEX SIGNAL DECOMPOSITION AND MODELING**



(57) Abstract: A system (100), method and program product for monitoring a complex signal for ultrasensitive detection of state changes, or for signature recognition and classification is provided. A complex signal is decomposed periodically for empirical modeling (106). Wavelet analysis, frequency band filtering or other methods (102) may be used to decompose the complex signal into components. A library (104) of signature data may be referenced for selection of a recognized signature in the decomposed complex signal. The recognized signature may indicate data being carried in the complex signal. Estimated signal data may be generated for determination of an operational state of a monitored process or machine using a statistical hypothesis test (112) with reference to the decomposed input signal.



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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US01/07490

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : G06F 15/00
US CL : 702/190, 182

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)
U.S. : Please See Continuation Sheet

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
extract, complex, signal, empirical, decomposition, memory

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5,774,379 A (GROSS et al.) 30 June 1998 (30.06.1998), column 4, lines 9-36.	1 and 29
A	US 5,757,309 A (BROOKS et al.) 26 May 1998 (26.05.1998), Figs. 1 and 2.	1 and 29
A	US 5,784,285 A (TAMAKI et al.) 21 July 1998 (21.07.1998), column column 2, lines 30-52.	1 and 29
A	US 5,495,168 A (DE VRIES) 27 February 1996 (27.02.1996), column 2, lines 54-67.	1 and 29
A, P	US 5,886,913 A (MARGUINAUD et al.) 23 March 1999 (23.03.1999), column 2, lines 6-44.	1, 3, and 29
A, P	US 6,076,088 A (PAIK et al.) 13.06.2000 (13.06.2000), column 4, lines 57-63	1 and 29



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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

"E" earlier application or patent published on or after the international filing date

"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

20 April 2001 (20.04.2001)

Date of mailing of the international search report

11 OCT 2001

Name and mailing address of the ISA/US
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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US01/07490

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

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

1. ☐ Claim Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claim 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. ☐ Claim 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:
Please See Continuation 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.: 1-10 and 29-34

Remark on Protest

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

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US01/07490

BOX II. OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I, claim(s) 1-10 and 29-34, drawn to a system and method for extracting information from a complex signal.

Group II, claim(s) 11-18, drawn to an apparatus for monitoring the operating condition of a system.

Group III, claim(s) 19-23, drawn to a method for providing a reference library of representative sets of correlated values for use in monitoring a system using an empirical model.

Group IV, claim(s) 24-28, drawn to a method for classifying a state of a system.

The inventions listed as Groups I-IV do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: Each grouping of claims are not related and should be separate applications.

Continuation of B. FIELDS SEARCHED Item 1: 702/190, 66, 67, 70, 71, 72, 73 82, 183, 184, 185, 190, 197, 193; 324/76.77, 76.11, 76.12, 76.28, 76.29; 714/100, 25, 29, 42, 819; 708/300, 290