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(54) **ANOMALY DETECTION BASED ON DIRECTIONAL DATA**

(75) Inventors: **Tsuyoshi Ide**, Kawasaki (JP); **Keisuke Inoue**, Sagamihara (JP); **Toshiyuki Yamane**, Yamato (JP); **Hironori Takeuchi**, Yokohama (JP)

(73) Assignee: **International Business Machines Corporation**, Armonk, NY (US)

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(58) **Field of Classification Search** ..... 714/799, 714/760; 382/197; 712/26; 707/100  
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,882,733 A \* 11/1989 Tanner ..... 714/752  
5,050,069 A \* 9/1991 Hillis et al. .... 703/13  
5,127,022 A \* 6/1992 Takegahara et al. .... 375/244  
5,271,022 A \* 12/1993 Berlekamp et al. .... 714/755

5,659,631 A \* 8/1997 Gormish et al. .... 382/166  
5,742,041 A \* 4/1998 Liu ..... 235/462.08  
5,778,415 A \* 7/1998 Marietta et al. .... 711/5  
5,818,032 A \* 10/1998 Sun et al. .... 235/494  
5,917,945 A \* 6/1999 Cymbalski ..... 382/192  
5,959,285 A \* 9/1999 Schuessler ..... 235/462.04  
5,974,172 A \* 10/1999 Chen ..... 382/166  
6,351,713 B1 \* 2/2002 Board et al. .... 702/42  
7,065,534 B2 \* 6/2006 Foltling et al. .... 707/102  
7,162,489 B2 \* 1/2007 Foltling et al. .... 707/102  
7,191,096 B1 \* 3/2007 Gross et al. .... 702/182

FOREIGN PATENT DOCUMENTS

JP 10-254899 9/2005

\* cited by examiner

*Primary Examiner*—M. Mujtaba K Chaudry

(74) *Attorney, Agent, or Firm*—Louis P. Herzberg

(57) **ABSTRACT**

Properly detects an anomaly on the basis of directional data that are obtained in sequence from a monitored object. An anomaly detecting method includes: sequentially generating directional data indicating a feature of each piece of monitored data correspondingly to the monitored data which are input in sequence; calculating the dissimilarity of the directional data to a reference vector; updating a moment of the distribution of the dissimilarity appearing when the directional data is modeled with a multi-dimensional probability distribution, based on the moment already corresponding to the monitored data; calculating a parameter determining the variance of the multi-dimensional probability distribution, on the basis of the moment; calculating a threshold of the dissimilarity on the basis of the multi-dimensional probability distribution the variance of which is determined by the parameter; and detecting an anomaly in the monitored data that corresponds to the dissimilarity if the dissimilarity exceeds the threshold.

**1 Claim, 10 Drawing Sheets**

