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(54) Title: METHODS AND DEVICES FOR ACCURATELY CLASSIFYING CARDIAC ACTIVITY

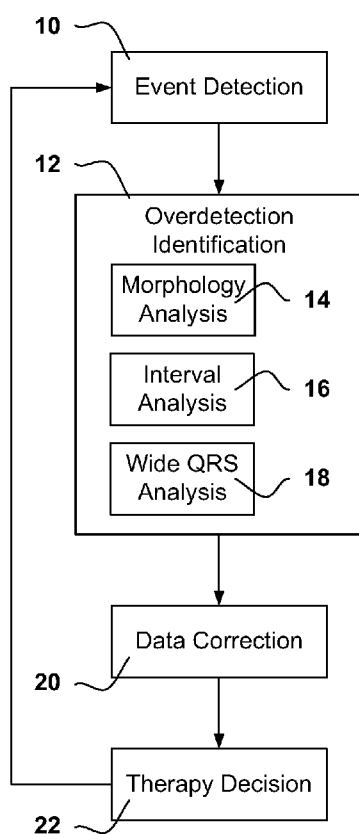


FIG. 1

(57) Abstract: Methods, systems, and devices for signal analysis in an implanted cardiac monitoring and treatment device such as an implantable cardioverter defibrillator. In some examples, captured data including detected events is analyzed to identify likely overdetection of cardiac events. In some illustrative examples, when overdetection is identified, data may be modified to correct for overdetection, to reduce the impact of overdetection, or to ignore overdetection. Several examples emphasize the use of morphology analysis using correlation to static templates and/or inter-event correlation analysis.



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A. CLASSIFICATION OF SUBJECT MATTER
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B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
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Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2006/116595 A1 (PALREDDY SUREKHA [US] ET AL) 1 June 2006 (2006-06-01) paragraphs [0034], [0091] paragraph [0032] - paragraph [0034] paragraph [0037] - paragraph [0040] paragraph [0078] - paragraph [0079] -----	1-17
A	US 2006/116725 A1 (PALREDDY SUREKHA [US] ET AL) 1 June 2006 (2006-06-01) paragraph [0012] - paragraph [0033] -----	1-17
A	WO 2004/105871 A (CAMERON HEALTH INC [US]; OSTROFF ALAN H [US]; WARREN JAY A [US]; BARDY) 9 December 2004 (2004-12-09) page 5, line 32 page 34, line 5 - page 35, line 2 ----- -/--	1-17

☒ 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 document but published on or after the international filing date
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- *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

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- *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.
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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2006/235476 A1 (GUNDERSON BRUCE D [US] ET AL) 19 October 2006 (2006-10-19) paragraph [0035] - paragraph [0054] paragraph [0085] - paragraph [0086] -----	1-17
A	US 7 330 757 B2 (OSTROFF ALAN H [US] ET AL) 12 February 2008 (2008-02-12) cited in the application column 4, line 32 - line 35 column 24, line 42 - column 26, line 11 column 27, line 50 - column 28, line 34 -----	1-17

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2009/043213

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 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 No. III Observations where unity of invention is lacking (Continuation of item 3 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 fees, this Authority did not invite payment of additional fees.
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.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☒ 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: 1-5

An implantable cardiac stimulus system comprising a canister housing operational circuitry having a canister electrode and a lead having a lead electrode. The operational circuitry configured to perform a method comprising: Detecting electrical events, constructing event representations comprising a series of events, comparing a first event representation to a template having a template fiducial point by identifying an event fiducial point in the first event representation and aligning it with the template event fiducial point and calculating a first correlation, again comparing the first event representation to the template by selecting a different alignment of the template and the event fiducial points, selecting from the first or the second correlation whichever indicates greater correlation as the correlation result for the first event representation, using a series of correlation results to determine whether accurate event detection is occurring, correcting data in response to inaccurate event detection, determining whether a likely cardiac arrhythmia is occurring, determining whether stimulus is needed and delivering it if necessary.

2. claims: 6-8

An implantable cardiac stimulus system comprising a canister housing operational circuitry having a canister electrode and a lead having a lead electrode. The operational circuitry configured to perform a method comprising: Detecting electrical events, constructing event representations, calculating a cardiac rate, comparing the event representations to a template representative of a known cardiac state to establish a set of correlations, analysing the set of correlations, determining whether a likely cardiac arrhythmia is occurring, determining whether stimulus is needed and delivering it if necessary.

3. claims: 9-12

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

An implantable cardiac stimulus system comprising a canister housing operational circuitry having a canister electrode and a lead having a lead electrode. The operational circuitry configured to perform a method comprising: Detecting electrical events, constructing event representations, calculating a cardiac rate, identifying one or more detected events as likely occurring due to overdetection, analysing intervals around the events identified as likely occurring due to overdetection to determine whether the likely overdetection is likely a T-wave, determining whether a likely cardiac arrhythmia is occurring, determining whether stimulus is needed and delivering it if necessary.

4. claims: 13-17

An implantable cardiac stimulus system comprising a canister housing operational circuitry having a canister electrode and a lead having a lead electrode. The operational circuitry configured to perform a method comprising: Detecting electrical events, constructing event representations, for a set of events N, N-1, N-2 and N-3, comparing the Nth event to each of the N-1, N-2 and N-3 events by correlation analysis, determining whether the set of events indicates overdetection, benign cardiac rhythm or likely cardiac arrhythmia, determining whether stimulus is needed and delivering it if necessary.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2009/043213

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 2006116595	A1	01-06-2006	AU 2005310008 A1	01-06-2006
			CA 2587856 A1	01-06-2006
			CN 101065059 A	31-10-2007
			EP 1827220 A1	05-09-2007
			JP 2008521487 T	26-06-2008
			US 2008119748 A1	22-05-2008
			WO 2006057736 A1	01-06-2006
US 2006116725	A1	01-06-2006	AU 2005310007 A1	01-06-2006
			CA 2587845 A1	01-06-2006
			CN 101102812 A	09-01-2008
			EP 1827598 A1	05-09-2007
			JP 2008521486 T	26-06-2008
			US 2009125075 A1	14-05-2009
			WO 2006057735 A1	01-06-2006
WO 2004105871	A	09-12-2004	AT 413903 T	15-11-2008
			AU 2004242990 A1	09-12-2004
			CA 2526844 A1	09-12-2004
			CN 1829554 A	06-09-2006
			EP 1631352 A1	08-03-2006
			EP 2025363 A2	18-02-2009
			JP 2007501099 T	25-01-2007
			US 2008132965 A1	05-06-2008
			US 2009054938 A1	26-02-2009
US 2006235476	A1	19-10-2006	CA 2605167 A1	26-10-2006
			EP 1877137 A1	16-01-2008
			JP 2008536633 T	11-09-2008
			WO 2006113698 A1	26-10-2006
US 7330757	B2	12-02-2008	US 2004254613 A1	16-12-2004