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(54) Title: METHOD AND APPARATUS TO ESTIMATE LOCATION AND ORIENTATION OF OBJECTS DURING MAGNETIC RESONANCE IMAGING

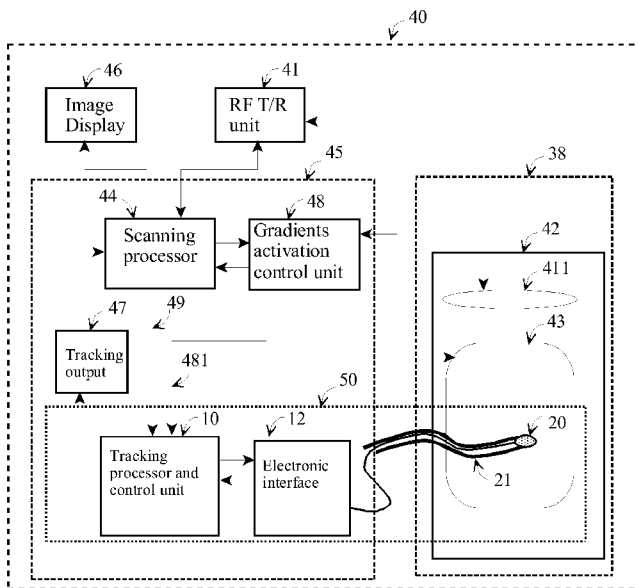


Fig. 1

(57) Abstract: Tracking based on the gradient fields of magnetic resonance imaging (MRI) scanners based on passive operation of the tracking system without any change of the scanner's hardware or mode of operation. To achieve better tracking performance, a technique to create a custom MRI pulse sequence is disclosed. Through this technique any standard pulse sequence of the scanner can be modified to include gradient activations specifically designated for tracking. These tracking gradient activations are added in a way that does not affect the image quality of the native sequence. The scan time may remain the same as with the native sequence or longer due to the additional gradient activations. The tracking system itself can use all the gradient activations (gradient activations for imaging and gradient activations for tracking) or eliminate some of the gradients and lock onto the specific gradient activations that are added to the custom pulse sequence.

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**INTERNATIONAL SEARCH REPORT**

International application No.

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**A. CLASSIFICATION OF SUBJECT MATTER**  
 IPC(8) - A61B 5/05 (2009.01)  
 USPC - 600/410  
 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(8) - A61B 5/05 (2009.01)  
 USPC - 600/410

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
 USPC - 600/301; 600/407; 600/410; 600/416; 600/424; 600/425; 324/307; 324/308; 324/309; 128/922; search terms below

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
 PubWEST ( PGPB,USPT,EPAB,JPAB); Google Patents; Google Scholar  
 Search Terms Used: MRI, magnetic, resonance, imaging, motion, tracking, gradient, coils, signal, activation, trigger, location, orientation, orthogonal, pair, sensor, instantaneous, time

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 6,492,814 B1 (WATKINS et al.) 10 December 2002 (10.12.2002) col 3, ln 18-25, 34-46, 64-67; col 4, ln 35-37; col 5, ln 52-58.	1-29
Y	US 5,947,900 A (DERBYSHIRE et al.) 07 September 1999 (07.09.1999) col 2, ln 10-28.	1-29
Y	US 6,516,213 B1 (NEVO) 04 February 2003 (04.02.2003) col 3, ln 28-35; col 4 ln 42-53; col 7, ln 15-18; col 10, ln 23-33, 63-67; col 11, ln 1, 52-66; col 12, ln 32-34; col 14, ln 5-19, 41-48; col 15, ln 48-60.	6, 9-11, 14-18, 21-24, 26
Y	US 2006/0074296 A1 (DUMOULIN et al.) 06 April 2006 (06.04.2006) para [0018].	12, 27

Further documents are listed in the continuation of Box C.

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Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Lee W. Young  PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774