Medical Imaging Devices Inventive Energy

2018

MEDICAL IMAGING DEVICES INVENTIVE ENERGY 2018

INTERNATIONAL PATENT CLASSES (IPC): Medical Imaging Devices

IPC Domain	Description
A61B5/05	Measuring for diagnosis by means of electric currents or magnetic fields
A61B5/107	Measuring physical dimensions, e.g. size of the entire body or parts thereof for measuring dimensions by non-invasive methods, e.g. for determining thickness of
A61B5/0091	Detecting, measuring or recording for diagnostic purposes; Identification of persons using light, e.g. diagnosis by transillumination, diascopy, fluorescence adapted for particular medical purposes for mammography
A61B6/547	Control of devices for radiation diagnosis involving tracking of position of the device or parts of the device
A61B5/0091	Detecting, measuring or recording for diagnostic purposes; Identification of persons using light, e.g. diagnosis by transillumination, diascopy, fluorescence adapted for particular medical purposes for mammography
G01R33/546	Interface between the MR system and the user, e.g. for controlling the operation of the MR system or for the design of pulse sequences
G06K9/48	Methods or arrangements for reading or recognising printed or written characters or for recognising patterns, e.g. fingerprints; by coding the contour of the pattern
G06K9/62	Methods or arrangements for recognition using electronic means
H05G1/20	X-ray apparatus involving X-ray tubes; Circuits therefor; with high-frequency ac; with pulse trains
H02M7/537	using semiconductor devices only, e.g. single switched pulse inverters

Medical imaging refers to methods and technology to build images of various parts of the human body for diagnostic and treatment purposes within digital health.

The emergence of innovative medical imaging devices such as 15-Tesla MRI machine, high-slice CT scanners, 4D and 5D ultrasound imaging devices, and innovations in digital X-ray technologies is likely to boost the demand for medical imagining devices in the global market. Market experts suggest that the medical imaging devices is expected to generate revenue of $46.65 billion by 2023, growing at a CAGR of 5.47%.

We identified following top 10 International Patent Classification (IPC) in the medical imaging devices domain through the study of key patents. The overall number of Applications published in the United States Patent and Trademark Office (USPTO) and Patents granted by USPTO are given in the table below (from the year 2010 till 2017. These are total numbers granted and published by the world at large at USPTO in that specific year.

S.No	IPC Domain	Year							
1	A61B5/05	2010	2011	2012	2013	2014	2015	2016	2017
	Application	342	275	222	93	60	81	101	101
	Granted	1451	1865	2338	2889	3307	3707	4065	4453
2	A61B5/107	2010	2011	2012	2013	2014	2015	2016	2017
	Application	19	21	38	72	104	139	171	187
	Granted	637	646	650	663	675	786	945	1137
3	A61B5/0091	2010	2011	2012	2013	2014	2015	2016	2017
	Application	10	11	12	11	18	16	1	1
	Granted	14	23	12	11	12	20	17	1
4	A61B6/547	2010	2011	2012	2013	2014	2015	2016	2017
	Application	27	46	50	40	48	40	30	2
	Granted	50	46	49	36	48	36	25	4
5	A61B5/065	2010	2011	2012	2013	2014	2015	2016	2017
	Application	30	50	42	101	90	56	30	1
	Granted	37	58	100	85	43	56	33	1
6	G01R33/546	2010	2011	2012	2013	2014	2015	2016	2017
	Application	2	6	13	10	30	16	12	1
	Granted	9	8	14	23	28	23	14	1
7	G06K9/48	2010	2011	2012	2013	2014	2015	2016	2017
	Application	99	106	126	81	32	49	85	73
	Granted	409	514	624	748	871	974	1073	1190
8	G06K9/62	2010	2011	2012	2013	2014	2015	2016	2017
	Application	483	319	509	523	530	1185	1815	1940
	Granted	1334	1567	1941	2326	2736	3530	4777	6488
9	H05G1/20	2010	2011	2012	2013	2014	2015	2016	2017
	Application	1	1	2	1	1	3	1	2
	Granted	87	90	90	91	92	95	98	101
10	H02M7/537	2010	2011	2012	2013	2014	2015	2016	2017
	Application	36	46	77	100	83	131	130	182
	Granted	134	145	156	196	236	295	402	568

STATE OF ART OF ANY TECHNOLOGY USING CRAFITTI's INVENTIVE ENERGY

Inventive Energy (IE) is a yearly metric of the trend of last five years of invention activity in the specific technological domain such as the medical imaging devices calculated based on a number of patent applications published and a number of patents granted in the respective technological domain. **Inventive energy is a composite metric of two indices – Patent Intensity Index and Patent Activity Index.**

CRAFITTI's **INVENTIVE ENERGY** measures the pace and intensity of **inventive activity** in a particular technological field. Inventive Energy provides a true picture of the state of the art of technology as it is a **composite metric** of Patents Granted and Patent Applications published in specific technology domains annually for a period of five years.

Inventive Energy in specific technology domains can be utilized by existing technology players, start-ups, new players, investors, VCs, Research and Development teams and technology and Product Strategy Teams to design more informed future.

Patent Intensity Index of a year is measured in terms of the yearly average of a number of total patents granted and patent applications published in last five years. *As an analogy, the Patent Intensity Index is denoted as the Mass which is reflected as a number of Patents and Applications granted and published respectively in the preceding five years.*

Patent Activity Index is measured in terms of the yearly average of *relative* pace of patent applications and granted patents in the IPC domain. *As an analogy, the Patent Activity Index denotes the Velocity or relative pace of Patents and Applications, granted and published respectively in the preceding five years, with higher weightage assigned to recent years.*

For any year, the two indices include a measure of yearly averages of last five years of a number of applications published and patents granted. For example, for 2017, these indices use data from years 2013-2017.

Patent Activity Index of top 10 medical imaging devices IPC classes for years 2014-2017

A value of **Patent Activity Index** *is less than 1.0 indicates that relative average number of applications filing is reducing compared to a number of patents being granted.* **The index also gives a red, amber and green signal.** Red indicates the value of the index is less than 1.0. Amber indicates it is between 1.0 and 2.0 and green indicates it is above 2.0, i.e., *the number of applications being published every year on an average is more than 2 times the number of patents being granted on an average*. A higher value of patent activity index is an indication of more recent inventive activity in the domain or the specific IPC class. In turn, a higher activity index will signify a higher Inventive Energy. *Activity Index is analogous to*

the velocity of the particle. The PAI (Patent Activity Index) of top 10 medical imaging devices IPCs for years 2014-2017 are given below.

IPC Domain	Description	BM-PAI 2014	BM-PAI 2015	BM-PAI 2016	BM-PAI 2017
A61B5/05	Measuring for diagnosis by means of electric currents or magnetic fields	0.07	0.04	0.03	0.02
A61B5/107	Measuring physical dimensions, e.g. size of the entire body or parts thereof for measuring dimensions by non-invasive methods, e.g. for determining thickness of	0.11	0.14	0.16	0.16
A61B5/0091	Detecting, measuring or recording for diagnostic purposes; Identification of persons using light, e.g. diagnosis by transillumination, diascopy, fluorescence adapted for particular medical purposes for mammography	1.14	0.98	0.62	0.82
A61B6/547	Control of devices for radiation diagnosis involving tracking of position of the device or parts of the device	3.30	1.07	1.13	0.85
A61B5/0091	Detecting, measuring or recording for diagnostic purposes; Identification of persons using light, e.g. diagnosis by transillumination, diascopy, fluorescence adapted for particular medical purposes for mammography	1.40	1.19	1.09	1.12
G01R33/546	Interface between the MR system and the user, e.g. for controlling the operation of the MR system or for the design of pulse sequences	16.40	8.98	5.97	4.39
G06K9/48	Methods or arrangements for reading or recognising printed or written characters or for recognising patterns, e.g. fingerprints; by coding the contour of the pattern	0.18	0.09	0.08	0.07
G06K9/62	Methods or arrangements for recognition using electronic means	0.23	0.27	0.32	0.30
H05G1/20	X-ray apparatus involving X-ray tubes; Circuits therefor; with high-frequency ac; with pulse trains	0.01	0.02	0.02	0.02
H02M7/537	using semiconductor devices only, e.g. single switched pulse inverters	3.53	0.43	0.39	0.36

*BM-PAI – *Bhushan Mishra Patent Activity Index* – named after its creators

As can be seen in the above table, the PAI for IPC class G01R33/546 (Interface between the MR system and the user, e.g. for controlling the operation of the MR system or for the design of pulse sequences) is above 2.0 for years 2014, 2015, 2016 and 2017, indicated in green.
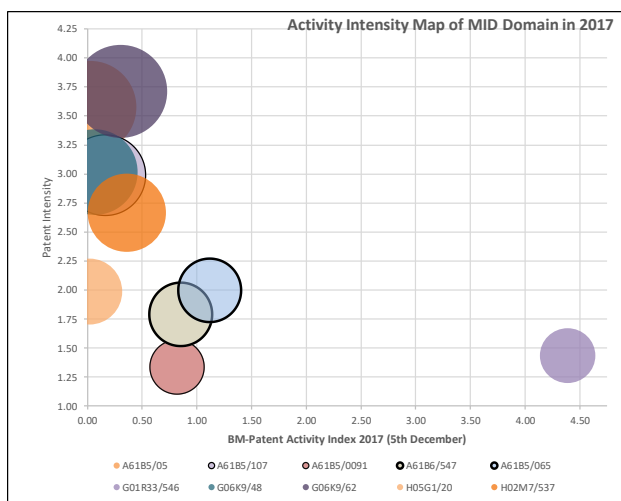
The PAI for A61B6/547 (Control of devices for radiation diagnosis involving tracking of position of the device or parts of the device) is above 2.0 for year 2014, indicated in green, and below 2.0 for the year 2015-2017, indicated in amber and red (below 1.0). Similarly, for the IPC class A61B5/065 (Determining position of the probe employing exclusively positioning means located on or in the probe, e.g. using position sensors arranged on the probe), the PAI is below 1.0 for years 2014, 2015, 2016 and 2017, indicated by amber.

The PAI for H02M7/537 (using semiconductor devices only, e.g. single switched pulse inverters) is above 2.0 for year 2014, indicated in green, and below 1.0 for the year 2015-2017, indicated in red (below 1.0). The PAI for A61B5/0091 (Detecting, measuring or recording for diagnostic purposes; Identification of persons using light, e.g. diagnosis by transillumination, diascopy, fluorescence adapted for particular medical purposes for mammography) is above 2.0 for year 2014, indicated in green, and below 1.0 for the year 2015-2017, indicated in red (below 1.0).

Further, the PAI for A61B5/05 (Measuring for diagnosis by means of electric currents or magnetic fields); A61B5/107 (Measuring physical dimensions, e.g. size of the entire body or parts thereof for measuring

dimensions by non-invasive methods, e.g. for determining thickness of tissue layer); G06K9/48 (Methods or arrangements for reading or recognising printed or written characters or for recognising patterns, e.g. fingerprints; by coding the contour of the pattern); G06K9/62 (Methods or arrangements for recognition using electronic means); and H05G1/20 (X-ray apparatus involving X-ray tubes; Circuits therefor; with high-frequency ac; with pulse trains) is red (below 1.0) for the years 2014-2017. This implies that the number of Patent Applications being published in the preceding 5 years (inclusive of current year) *remains less* than the number of Patents being granted. This indicates a reducing Invention activity in the specific domain. Thus, it can be concluded that IPC domains A61B5/05, A61B5/107, G06K9/48, and H05G1/20 are seeing reducing Invention Activity and has low invention velocity from 2010 to 2017.

*G01R33/546, and A61B5/065 are the prominent IPC classifications in the medical imaging device technology which talks about **Interface between the MR system and the user, e.g. for controlling the operation of the MR system or for the design of pulse sequences and Determining position of the probe employing exclusively positioning means located on or in the probe, e.g. using position sensors arranged on the probe** respectively. The inventive activity in H02M7/537 was higher in the year 2014, since then the patent activity has been reducing as the number of Patents being granted has started increasing. Further, the inventive activity in G01R33/546 was also higher in the year 2014, since then the patent activity has been reducing. However, the inventive activity of G01R33/546 is still higher than other key IPC classes.*


Activity Intensity Map of MID Domain in 2017

Legend: A61B5/05, A61B5/107, A61B5/0091, A61B6/547, A61B5/065, G01R33/546, G06K9/48, G06K9/62, H05G1/20, H02M7/537

Activity Intensity Maps of Top 10 medical imaging devices IPC classes in the year 2014 and 2017

Activity Intensity Map (**AIM**) of a set of IPC classes is a Crafitti proprietary visualization of intensity in terms of a number of patents granted and patent applications published, and inventive activity in terms of relative pace of patent applications and granted patents in any IPC domain. For any year say 2014, these indices include a measure of yearly averages of last five years of a number of applications published and patents granted. For example, for 2014, these indices use data from years 2010, 2011, 2012, 2013 and 2014.

Medical imaging device Inventive Energy of Top 10 IPC classes

IPC Domain	Patent Activity Index				Patent Intensity				INVENTIVE ENERGY			
IPC	BM-PAI 2014	BM-PAI 2015	BM-PAI 2016	BM-PAI 2017	2014	2015	2016	2017	2014	2015	2016	2017
A61B5/05	0.07	0.04	0.03	0.02	3.41	3.47	3.53	3.58	0.22	0.14	0.11	0.08
A61B5/107	0.11	0.14	0.16	0.16	2.85	2.88	2.93	2.99	0.30	0.39	0.46	0.49
A61B5/0091	1.14	0.98	0.62	0.82	1.43	1.47	1.41	1.33	1.62	1.43	0.87	1.09
A61B6/547	3.30	1.07	1.13	0.85	1.89	1.94	1.91	1.79	6.26	2.07	2.15	1.52
A61B5/0091	1.40	1.19	1.09	1.12	2.10	2.13	2.10	2.00	2.95	2.54	2.29	2.23
G01R33/546	16.40	8.98	5.97	4.39	1.16	1.36	1.45	1.43	19.09	12.20	8.68	6.30
G06K9/48	0.18	0.09	0.08	0.07	2.79	2.92	2.97	3.02	0.50	0.25	0.24	0.20
G06K9/62	0.23	0.27	0.32	0.30	3.39	3.48	3.60	3.71	0.77	0.94	1.14	1.13
H05G1/20	0.01	0.02	0.02	0.02	1.96	1.97	1.98	1.99	0.02	0.04	0.03	0.04
H02M7/537	3.53	0.43	0.39	0.36	2.33	2.47	2.56	2.67	8.23	1.06	1.00	0.96

Inventive Energy for the year 2014 for IPC class A61B5/05 is simply a product of Patent Activity Index for the year 2014 (in this case a value of 0.07) and Patent Intensity for the year 2014 (in this case a value of 3.41). The Inventive Energy for the year 2014 for IPC domain A61B5/05 comes out to be 0.07 x 3.41 = 0.22, as shown in the Table. In general, the Inventive Energy of IPC class G01R33/546 (Interface between the MR system and the user, e.g. for controlling the operation of the MR system or for the design of pulse sequences) is highest among these top 10 IPC classes.

Medical Imaging Device (MID) Inventive Energy 2014-2017
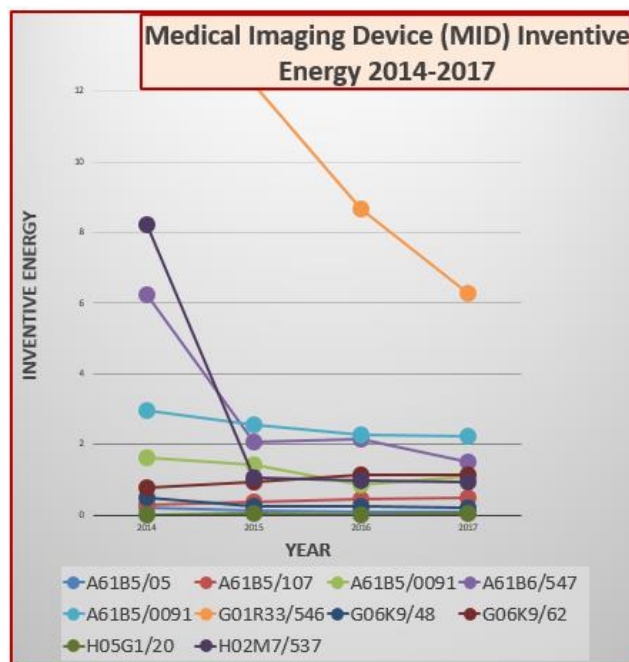
Key Findings

Due to its inherent simplicity and utilization of substantial information on published and granted patents, the present study on the inventive energy provides a de facto standard for enterprises active in the medical imaging devices to evaluate the front edge of technology in various applications of the medical imaging devices.

IPC classes on the Interface between the MR system and the user, e.g. for controlling the operation of the MR system or for the design of pulse sequences (G01R33/546) and determining position of the probe employing exclusively positioning means located on or in the probe, e.g. using position sensors arranged on the probe (A61B5/065) have seen the tremendous inventive energy in the 2014-2017 Index. Other prominent IPC class is on control of devices for radiation diagnosis involving tracking of position of the device or parts of the device (A61B6/547) has also been quite active among the medical imaging enthusiasts and R&D teams.

One of the findings from the present inventive energy study is that the patenting activity was higher in the medical imaging domain in the year 2014 and 2015. Further, there is a decrease in the patent activity in the control of devices for radiation diagnosis involving tracking of position of the device or parts of the device which were higher in the year 2014. However, the filing trend in this domain is relatively better than the IPC H04B7/26 which talks about measuring for diagnosis by means of electric currents or magnetic fields.

Further, the reduction in Inventive Energy of G01R33/546 from 2014 value of nearly 19.09 to the value of 6.30 in the year 2017, *indicates the trend of Patents grants has started in the period that typically brings down the Inventive Energy as it is a function of the ratio of applications published and a patent granted for the particular year.* Furthermore, the present inventive energy study identified that inventors are active in the next-generation medical imaging devices that help in prevention, diagnosis and treatment planning, and disease management.

IPC classes with high Inventive Energy typically will have higher business potential and growth in the medical imaging technology. The Inventive Energy can be utilized to create the medical imaging device Inventive Strategy to find problems in high inventive energy IPC classes. This can be a leading indicator for not only any startup or disruptor but also to existing patent owners to expand and strengthen their portfolio through this guidance rather than letting serendipity and opinion about future guide their inventive effort.

As the patent examiner not only evaluate the patentability of the corresponding technology but also assess the legal aspects of the filed patent application at various levels of scrutiny before granting the patent, therefore, patent grant trends identified by the present inventive energy study in the medical imaging technology will enable the decision maker with the due-diligence aspects of the medical imaging technology.

Any organization willing to invest in the medical imaging technology can utilize invention energy metric in general and this study in particular, as it automatically takes care of three major inputs required to understand the state of the art of medical imaging technology – Patent Applications, Granted Patents and Specific IPC classes relevant to medical imaging technology in a composite metric.

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Contact : CRAFITTI CONSULTING PRIVATE LIMITED
 Email: navneet.bhushan@crafitti.com OR
amit.mishra@crafitti.com

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