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European Society of Medical Imaging Informatics

EuSoMII is a professional healthcare organization that provides its members and the radiological community with up-to-date information on the latest innovations and achievements in medical imaging informatics by supporting education, research and events related to the top-tier software in radiology.

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Insights into Imaging (2018) 9 (Suppl 3):S705–S708
https://doi.org/10.1007/s13244-018-0632-3

EuSoMII ACADEMY

Game changers in radiology

The impact of informatics and A.I. on medical imaging

Jointly organized by EuSoMII, SIIM and Erasmus MC

Rotterdam - November 18th, 2017

A1 – Artificial Intelligence: Hype, Reality, and Future Applications in Medical Imaging

Author(s): Eliot Siegel
Disclosure statement: No relevant disclosures
Topic: Artificial Intelligence
Abstract categories: Machine Learning

Abstract

High profile challenges in machine learning and artificial intelligence such as the Jeopardy! Match in 2011 and Google Deep Mind's triumph at "Go", have resulted in unprecedented speculation about the end of radiology. Articles in the New England Journal and JACR by Ezekiel Emanuel in recent months have proclaimed that, "in a few years there may be no specialty called radiology". Stanford's Andrew Ng suggested in The Economist that a "radiologist may now be in greater danger of being replaced by a machine than his own executive assistant". This comes after a prominent West Coast start-up proclaimed an end to the "wasted protoplasm, which is the radiologist at the workstation"! Despite these concerns there are numerous reasons why radiologists need not fear AI.

1. A wide variety of problems in statistics and specifically in medicine can be solved best with the creation of a "machine" which can provide a simulation or model to discern patterns in a dataset and make predictions.
2. Machine learning is an advanced statistical technique that accomplishes this
3. Interpretation of medical images is much more difficult than Deep Learning/Machine learning experts have anticipated for a variety of reasons and radiologists will not be replaced for quite a long time
4. There are many problems involving quality, efficiency, and safety in medicine and medical imaging that can be addressed with machine learning/deep learning approaches quite effectively. The application of this approach will have a profound impact on the practice of medicine in the future.

A2 – Value-based imaging and artificial intelligence: ensuring the future of radiology

Author(s): Jacob J. Visser
No disclosures
Topic: Value-based imaging and Artificial intelligence
Abstract categories: Educational

Abstract

Currently, the two key keywords in medicine are: value-based health care and artificial intelligence. By implementing these concepts there is an important opportunity to change the way radiology is practiced and the future of radiology can be ensured.

To operationalize the previously noted concepts, radiology needs to focus on 3 main topics, namely: automation, quantification / datafication and integration.

Firstly automation, because the computer can do a lot of tasks using artificial intelligence we are currently performing as a radiologist. This will allow the radiologist to spend more time on value-adding activities. Secondly quantification / datafication, as there is tons of information in an image that can and, in fact, needs to be quantified. Furthermore, free-text reports should be abandoned and be replaced by structured reports. The obtained parameters guide the clinician in choosing the most value-adding treatment for the patient. Also, these parameters can be used to develop artificial intelligence algorithms. Finally integration, as the radiologists' task is to interpret the important data, advise on the added value of additional diagnostic tests, such as the need for more imaging, pathology, or a laboratory test, and integrate information to guide clinicians in their decisions.

Therefore, automation, quantification / datafication and integration by means of artificial intelligence will ensure the future of radiology in the era of value-based imaging.

A3 − Unlocking patterns in medical images with AI

Author(s): Ben Glocker
Disclosure statement
The author is scientific advisor for Kheiron Medical Technologies
Topic: Artificial Intelligence
Abstract category: Scientific

Abstract
Artificial intelligence has the potential to address a major crisis in medical imaging. With an ever increasing complexity, volume of data and economic pressure the interpretation of medical images pushes human abilities to the limit. According to The Royal College of Radiologists, in the UK alone there are more than 300,000 patients waiting for more than a month for their imaging results. For some areas of image-based diagnosis error rates of up to 30% have been reported.
The aim of our research at the BioMedIA group at Imperial College London is to develop machines capable of analysing and interpreting medical scans with super-human performance. We utilise cutting-edge deep learning technology to automatically extract clinically useful information from images which otherwise would be difficult or impossible to retrieve. We have successfully applied this technology to analyse brain and cardiac images, where our computational tools enable automatic, quantitative assessment of anatomical structures and pathologies such as brain lesions. Our lab has recently presented a novel approach to segment brain tumors with unprecedented accuracy which was ranked top at the international Multimodal Brain Tumor Segmentation Challenge (BraTS) 2017.
Despite the recent successes and promising results, we still face major challenges in deploying this technology in clinical practice. Future research needs to focus on making machine learning methods more robust and trustworthy. We observe significant degradation of performance on new data and automatic predictions come with limited interpretability. We present some recent ideas and preliminary results to tackle these challenges.

A4 − Image sharing and biobanks

Author(s): Bernard Gibaud
Disclosure statement
Topic: Imaging biobanks, semantic web
Abstract categories: Scientific

Abstract
Data sharing has become a primary issue in many domains of modern life, as a result of the progress of communication and storage technology and spurred by the huge possibilities offered by recent data mining technology (big data mining, deep learning). Given the prominent role of medical imaging in modern medicine and especially in precision medicine, the development of imaging biobanks appears as critically important for biomedical research towards achievement of precision medicine.
The presentation first summerized the most basic motivations for developing imaging biobanks. It focused on recent efforts towards linking imaging biobanks and classical (specimen) biobanks, in the context of a collaboration between the European Society of Radiology and the BBMRI-ERIC research infrastructure, implemented as a two-step process. The first step consists in offering the possibility to describe image collections as part of the BBMRI-ERIC Directory, thus requiring to extend the data model of this database to include descriptive items concerning medical image collections. A second step is also envisaged, involving the design of information models for describing individual image datasets, as well as important derived data, such as imaging biomarkers. The design of these information models is envisaged as an extension of the MIABIS / OMIABIS model (Minimum Information About BIObank data Sharing). Emphasis was specifically put on the additional possibilities resulting from the use of semantic web technologies (i.e. ontology-based approach), seen as the most appropriate to ensure linking and managing consistency with data other domains (linked data, federated semantic repositories).

A5 − Deep learning: basic principal

Author(s): Bram van Ginneken
Disclosure statement
Topic: Image analysis
Abstract categories: Educational

Abstract
For more than half a century, researchers have been programming computers to detect abnormalities en make predictions from medical images. Until a few years ago, the standard approach was to think carefully about what characteristic numbers (features) could be computed from the image. A set of such numbers was then mapped to a prediction using a training data set of images with known lesions or outcome, and a classifier, or statistical model. This field is known as machine learning. Deep learning is fundamentally different because now the images are directly used as input to a neural network. The step is designing the right features to be computed is omitted. The network is trained using a large data set of images with known lesions or outcome. Training here means endlessly fiddling with the internal weights of the network until the network predicts the correct outcome for new images.
Since 2012, deep learning has been applied to over 300 tasks in medical image analysis. I highlighted some recent results in the analysis of fundus photographs for the detection of diabetic retinopathy, in computational pathology for the detection of metastases from lymph node biopsies and in chest CT analysis for the detection of nodules and the prediction of the presence of lung cancer. In all these applications, deep networks perform comparably to human experts.
The results I presented demonstrate that with today's technology it is possible to automate visual tasks that humans can perform after an extended period of training. However, there are still few such automated systems validated and widely used in practice. Moreover, clinicians perform thousands of medical

image analysis tasks in their daily work. Thus, there is much work to do in developing these systems, and this endeavor has a high potential for making health care more affordable and more effective.

A6 − Integrating data in the Structured Report

Author(s): Daniel Pinto dos Santos,
Disclosure: None
Topic: Structured reporting, interoperability, computer applications
Abstract categories: Educational

Abstract
Although structured reporting is still not widespread in clinical routine, it has been a major topic in the radiological community for quite a while. With the development and publication of the IHE MRRT profile, actors and transactions in structured reporting have been very well described. The profile allows for data from different sources to be incorporated in the structured report (e.g. via HL7, from RIS, PACS or EMR). Moreover, template modules can be integrated in other templates and structured reporting templates themselves can already have implicit data integrated such as knowledge about categorization of certain pathologies. In this talk an overview of the existing possibilities to enrich structured reports with data from various sources will be given, as well as an outlook where data coming from structured reports can be used for other applications.

A7 − Role of image computing in radiology - opportunity or threat?

Author(s): Paul Suetens
Disclosure: None
Topic: AI, Machine learning, Image computing
Abstract categories: Educational

Abstract
The 1970s was the decade that “computed imaging” radically changed the field of radiology. Today “image computing” has become sufficiently mature to have a similar influence on this discipline. In this talk the principles of image computing will be shortly summarized and its potential will be illustrated on clinical examples of computer-assisted detection, screening, quantitative measurements, evidence-based diagnosis, early outcome prediction of therapy, and 3D visualization. Obviously, exploiting this new technology is a logical evolution in the context of value-based health care. It should therefore not be neglected, but instead, be considered as an opportunity and adopted by radiologists.

A8 − Who Controls Patient Data in the Era of A.I.: man or machine?

Author(s): Peter M.A. van Ooijen, MSc, PhD, CPHIT
Disclosure: None
Topic: Artificial Intelligence, privacy, data security
Abstract categories: Educational

Abstract
Recent years has shown an explosive growth in the use of Artificial Intelligence (AI) and Deep Learning not in the least for medical applications. These new technological developments have started a whole new discussion on privacy of data processed by these computerized systems. Especially those applications in health care demand a high level of patient privacy and patient data security. The actual ownership of medical data is also part of this discussion where we can have different situations with original, de-identified, anonymized and processed data. Questions like what data is still personal data for an individual patient or participant in a clinical trial and who actually owns the data that is produced with self-learning computer systems. This educational course will discuss these issues with respect to ownership, intellectual property and the different aspects that are involved in this when moving towards the era of AI.

A9 − Transitioning to AI-Powered Highly Automated Radiology

Author(s): J. Raymond Geis
Disclosure statement: No conflict of interest, and nothing to disclose
Topic: Radiology AI; Imaging Informatics; Radiology practice
Abstract categories: Imaging Informatics, Radiology practice

Abstract
In the automobile industry, self-driving cars are known as Highly Automated Vehicles (HAVs). Work on HAVs has been going on for decades. Today, the general world still drives cars much like we did years ago, though now our cars will automatically brake for objects in front of us, or will warn us if we stray from our lane. These are narrow AI tools, each designed to perform a focused task.
Advances in computing power, algorithms and digital data provide the basis for a future of highly-automated radiology (HAR). Similar to cars, we have just entered a phase that will probably last for decades, where we will still “drive” radiology similar to how we do today, but with the addition of our own narrow AI tools. These narrow AI tools broadly fit three groups:
· Radiomics, screening for disease, computer-assisted detection
· Knowledge management and Natural Language Processing (NLP)
· Protocol and workflow management – aka “Protocolomics”
It is surprisingly easy to write a computer program to do a radiology-AI task on well-defined, highly curated, local data. It is difficult, however, to build an AI product that will work on diverse, heterogeneous input data. On top of this are ethical and bias issues, how to handle rare but “do-not-miss” cases, and how to verify that a “learning algorithm” is learning the correct things, and becoming better rather than worse for all situations.