Artificial Intelligence and Radiology

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ELHT
Why Artificial Intelligence (AI) ?

- Vastly Improve quality of care
- Timely diagnosis
- Aid stretched radiology workforce
- Automation of repetitive measurements
- Quantification of biomarkers
- Autonomous triaging of emergent findings
Challenges...

- Vast imaging data sets in PACS
- Access is difficult due to confidentiality
- Access can enable data analysis and training of algorithm to recognise the wide variation in imaging of various conditions
- Issues like Google-Deep mind
Google DeepMind 1.6m patient record deal 'inappropriate'  

National data guardian says patient data transfer from Royal Free to Google subsidiary has ‘inappropriate legal basis’ as information not used for direct care

The national data guardian said the transfer of patient data from the Royal Free was unsound as it was first used to test a new app, Streams. Photograph: Alamy

The transfer of 1.6m patient records to Google’s artificial intelligence company DeepMind Health has been criticised for its “inappropriate legal basis” by the UK’s national data guardian.
Success....
Our mission is to help radiologists detect breast cancer earlier using deep learning.
Hi Alex, how can I help?

I've got a really bad headache and I don't know what to do...

No problem, let me ask you a few questions
ASPIRE™ Service

CQC-regulated clinical service to identify vertebral fractures

13 Oct, 2017
Machine Learning Technology
Vertebral Fracture Patients Known to the FLS

<table>
<thead>
<tr>
<th>Hospital Site</th>
<th>Number of VF Found</th>
<th>Number of VF Patients Known to the FLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxford</td>
<td>53</td>
<td>8</td>
</tr>
<tr>
<td>Croydon</td>
<td>26</td>
<td>3</td>
</tr>
<tr>
<td>Salford</td>
<td>75</td>
<td>-</td>
</tr>
<tr>
<td>Blackburn</td>
<td>47</td>
<td>4</td>
</tr>
<tr>
<td>Nottingham</td>
<td>15</td>
<td>13</td>
</tr>
<tr>
<td>Cambridge</td>
<td>42</td>
<td>-</td>
</tr>
<tr>
<td>TOTAL</td>
<td>258</td>
<td>28</td>
</tr>
</tbody>
</table>

- But very few make it to the FLS
Application of AI locally?

- Bony metastasis detection
- Articular cartilage assessment
- Rotator cuff tear detection
Application of AI locally?

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- Articular cartilage assessment
- Rotator cuff tear detection
Detection of Sclerotic Spine Metastases via Random Aggregation of Deep Convolutional Neural Network Classifications

Holger R. Roth*¹, Jianhua Yao¹, Le Lu¹, James Stieger¹, Joseph E. Burns², and Ronald M. Summers¹

¹Imaging Biomarkers and Computer-Aided Diagnosis Laboratory, Radiology and Imaging Sciences, National Institutes of Health Clinical Center, Bethesda, MD 20892-1182, USA.
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(normal controls). The proposed method reduces the number of FP/vol. from 4 to 1.2, 7 to 3, and 12 to 9.5 when comparing a sensitivity rates of 60%, 70%, and 80% respectively in testing. The Area-Under-the-Curve (AUC) is 0.834. The results show marked improvement upon previous work.
Application of AI locally?

- Bony metastasis detection
- **Articular cartilage assessment**
- Rotator cuff tear detection
Artificial Intelligence for the Interpretation of Musculoskeletal MR Images

Giuseppe Marbach, PhD, Data Scientist, Balzano Informatik AG, Zürich; René Balzano, MSc

Outcome
We trained our AI models with 12,000 MR studies (images and reports) for the meniscus region and have reached an accuracy of 75% on a test set of 800 studies, see Tab-1.

<table>
<thead>
<tr>
<th></th>
<th>precision</th>
<th>recall</th>
<th>test data</th>
</tr>
</thead>
<tbody>
<tr>
<td>pos</td>
<td>0.72</td>
<td>0.74</td>
<td>359</td>
</tr>
<tr>
<td>neg</td>
<td>0.78</td>
<td>0.76</td>
<td>441</td>
</tr>
<tr>
<td>average total</td>
<td>0.75</td>
<td>0.75</td>
<td>800</td>
</tr>
</tbody>
</table>

Tab-1: Accuracy for meniscus tears on our test set
Deep Learning Approach for Evaluating Knee MR Images: Achieving High Diagnostic Performance for Cartilage Lesion Detection

Fang Liu, Zhaoye Zhou, Alexey Samsonov, Donna Blankenbaker, Will Larison, Andrew Kanarek, Kevin Lian, Shivkumar Kambhampati, Richard Kijowski

Published Online: Jul 31 2018 | https://doi.org/10.1148/radiol.2018172986

Abstract

Purpose

To determine the feasibility of using a deep learning approach to detect cartilage lesions (including cartilage softening, fibrillation, fissuring, focal defects, diffuse thinning due to cartilage degeneration, and acute cartilage injury) within the knee joint on MR images.

Results

The sensitivity and specificity of the cartilage lesion detection system at the optimal threshold according to the Youden index were 84.1% and 85.2%, respectively, for evaluation 1 and 80.5% and 87.9%, respectively, for evaluation 2. Areas under the ROC curve were 0.917 and 0.914 for evaluations 1 and 2, respectively, indicating high overall diagnostic accuracy for detecting cartilage lesions. There was good intraobserver agreement between the two individual evaluations, with a κ of 0.76.

Conclusion

This study demonstrated the feasibility of using a fully automated deep learning–based cartilage lesion detection system to evaluate the articular cartilage of the knee joint with high diagnostic performance and good intraobserver agreement for detecting cartilage degeneration and acute cartilage injury.

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Application of AI locally?

- Bony metastasis detection
- Articular cartilage assessment
- **Rotator cuff tear detection**
Predicting Rotator Cuff Tears Using Data Mining and Bayesian Likelihood Ratios

Hsueh-Yi Lu, ¹ Chen-Yuan Huang, ¹ Chwen-Tzeng Su, ¹ and Chen-Chiang Lin ², *

Vince Grolmusz, Editor

Conclusions

Our predictive data mining models, combined with likelihood ratios and Bayesian theory, appear to be good tools to classify rotator cuff tears as well as determine the probability of the presence of the disease to enhance diagnostic decision making for rotator cuff tears.
Next steps...

- Exploratory
- Test pilot with annotated database
- Potential to harness the huge PACS database partnering with UCLan- Prof Bogdan and team