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Wolfram A. Bosbach[1]* MD PhD, Bence Nemeth[1] MD, Jan F. Senge[2,3] MA,
Lukas Ebner[1] MD, Suzanne E. Anderson[1] MD, Pawel Dlotko[3] PhD,
Keivan Daneshvar Ghorbani[1] MD, Johannes T. Heverhagen[1] MD PhD

Open access AI tools in clinical support roles - an example of shoulder implant recognition

[1] Department of Diagnostic, Interventional and Pediatric Radiology (DIPR), Inselspital,
Bern University Hospital, University of Bern, Switzerland
[2] University of Bremen, Department of Mathematics and Computer Science, Bremen, Germany
[3] Max-Planck Dioscuri Centre in Topological Data Analysis, Warsaw, Poland
*presenter and corresponding author: WolframAndreas.Bosbach@Insel.CH

Disclosure

The authors have no competing financial interests.

Motivation:

Uptake of novel artificial intelligence (AI) technology is happening at a rather slow pace in medicine / radiology

Reasons include:

- Reluctance of medical practitioners to get involved with computer coding
- Lack of available computing resources

Research approach:

For overcoming barriers to technology uptake, we are working towards building an AI open source class labelling tool:

- running on freeware resources online
- requiring no advanced local hardware or software
- optimised for a typical musculoskeletal (MSK) 4-class labelling task
- as eg given in [1-3] by four classes of shoulder implants

Method and Materials:

Open access online computing resources

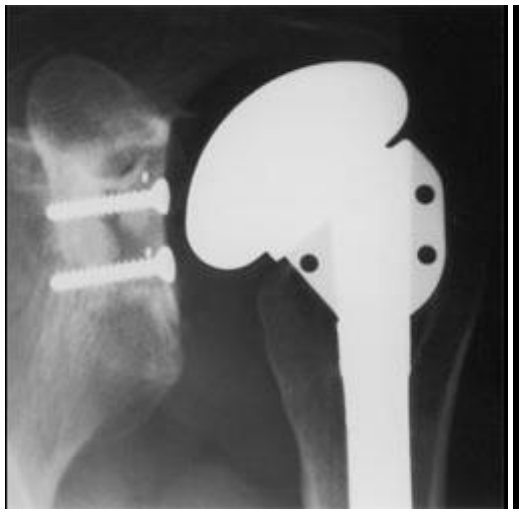
- Development environment:
  - Google-Chrome
  - Google-Drive
  - Google-Colab
- Code package: Google-TensorFlow with Google-EfficientNet in Python

Open access image dataset

Shoulder Implant X-Ray Manufacturer Classification Dataset

- Available in the machine learning repository of the University of California in Irvine (California, USA) [1-3]
- Labelled by 4 different manufacturers (83 Cofield, 294 Depuy, 71 Tornier, 149 Zimmer)
- 8-bit grayscale [jpeg], 50^2 pixel

Sample images:



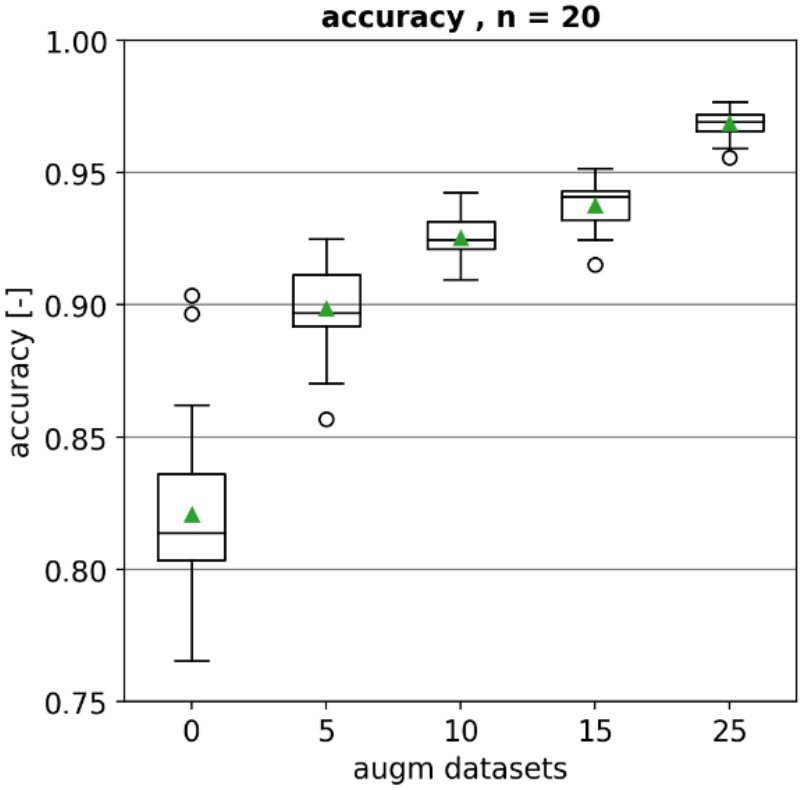
Cofield 79

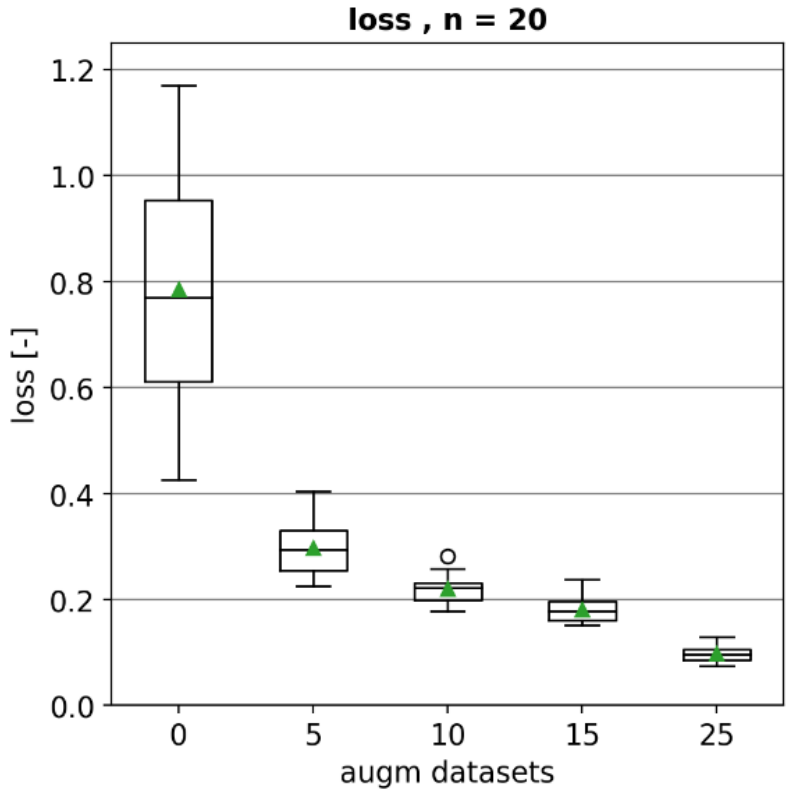
Zimmer 27

Image source: [1-3]

Current results: mesh learning achievable

Influence of greater data augmentation: Accuracy and loss improve under training (each 25 epochs, n=20 iterations)



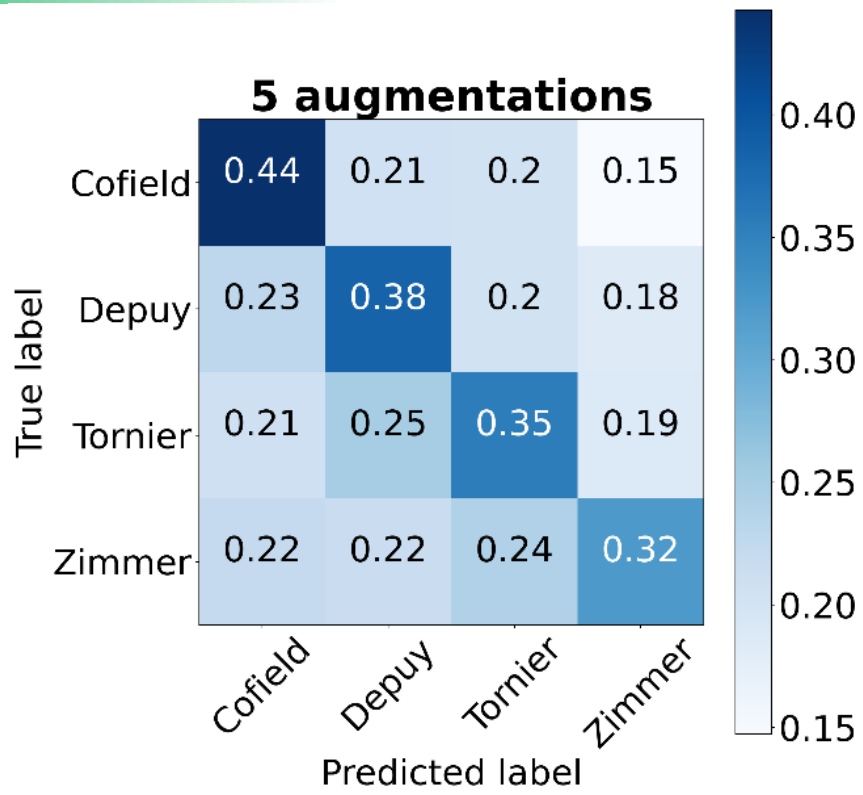


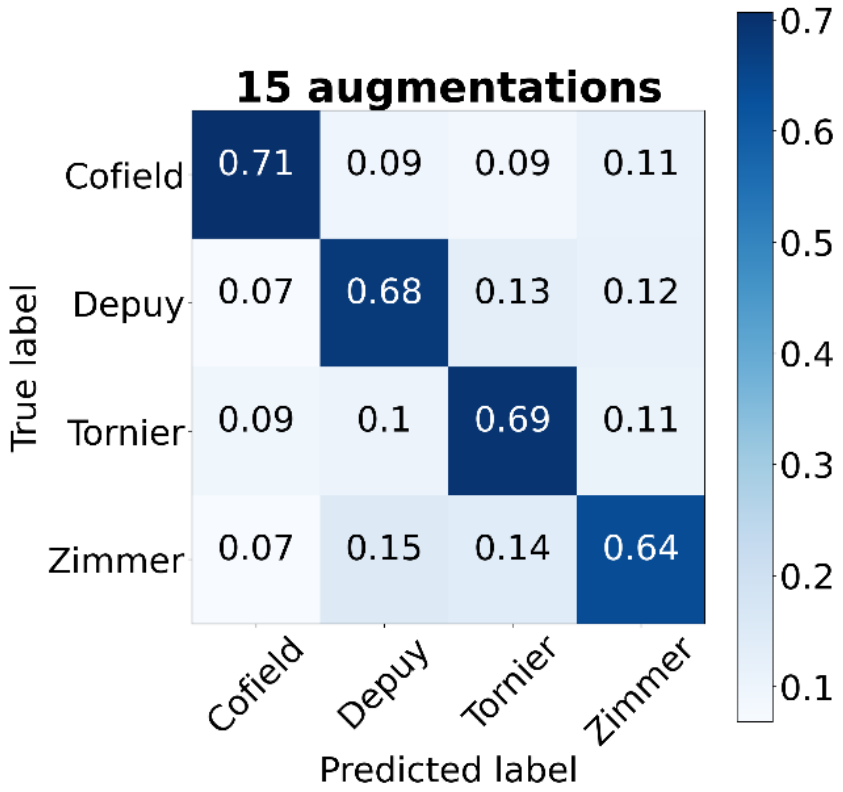
Mesh learning

- Google-EfficientNet achieves mesh learning with increasing performance
- Measurable in accuracy and loss
- Data augmentation improves learning behaviour further

Current results: labelling convergence for shoulder implant image set

Confusion matrix: Improvement under greater data augmentation





Labelling task

- Visualization by confusion matrix
- Model convergence towards main diagonal for greater data augmentation

Next steps

- Cross validation and activation mapping

Conclusions

- Chosen open access online computing resources competent for intended labelling task
- Similar AI tools can be provided worldwide and support clinical work of radiologist
- No requirements for advanced local hardware
- Interface building possesses potential for increased technology uptake [4]

Limitations to online tools

Data protection

- Particularly in clinical medicine

Medical research

- Research groups could apply current online tools to research images
- Greater accessibility of novel pattern recognition algorithms

Clinical medicine

- Local applications without need for internet access might be required

Acknowledgements

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