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## Guest editorial

# Will intelligent machine learning revolutionize orthopedic imaging?

In this issue of Acta, Olczak et al. present the first data on artificial intelligence (AI) deep learning applied to orthopedic trauma radiographs, which hold promise to improve both quality and quantity of future image processing. AI was first associated with the invention of robots, and among medical applications robotic surgery developed. Many physical applications, when becoming routine technologies, are no longer considered AI, however. Among virtual AI applications, chess computers that could learn from experience and their own mistakes received attention, eventually beating even world champions (Deep Blue 1997). In medicine, expert systems for diagnosis and optimized interventions using electronic health records became heralded (cf. Hamet and Tremblay 2017). With recent advances in computer power paralleled by enhanced mathematical algorithms, we are currently experiencing a rapid development within medical imaging, including conventional radiography, CT, and MRI. The term deep (machine) learning was coined for the activity of electronic neural networks arranged in multiple layers, mimicking the organization of the brain. Huge data sets with thousands of images are used to train the network, while using the interpretation of expert radiologists as the initial gold standard. Tumor recognition (in the lungs) became an early priority, where complex image data not previously labeled by radiologists could help reveal the diagnosis and even the prognosis (van Ginneken 2017). Conventional chest radiographs and CT images may now be reviewed automatically with the diagnostic quality of experienced radiologists, yet at an amazing rate that will probably be multiplied in the near future. Jamaludin et al. (2017) recently stated that automated reading of radiological features from MRIs of the lumbar spine, without human intervention, was comparable with the results of an expert radiologist. Olczak et al. present in this issue how standard radiographs of hand, wrist, and ankle fractures were automatically diagnosed at a human-expert level, while, as a first step, identifying both the examined body part and view. A tireless, fast, and accurate diagnostic machine would indeed be an asset in a setting without access to radiologic expertise. Deep learning networks may in fact incorporate both image data and the radiology text report for best judgment of an image, or for further learning of the network (cf. van Ginneken 2017). Furthermore, Olczak et al. point to an even more challenging thought: that we actually might not need radiographical classification systems for decision-making. It is indeed a challenging thought that, instead of using traditional classification systems, we may link the machine-learning data directly to disease outcome; and perhaps include even the effect of surgical intervention. A recent study (Ashinsky et al. 2017), isolating subtle changes in cartilage texture of knee cartilage in multiple MRI T2-mapped images, could analogously predict the onset of early symptomatic (WOMAC score) knee osteoarthritis 3 years later. Perhaps we are entering a new era of orthopedic diagnostic imaging where computers and not the human eye will comprehend the meaning of image data. With such a paradigm shift for orthopedic surgeons, and even more so for radiologists, one might hope that new intuitive perceptions will arise for us to open the black box of machine-learning data.

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Ashinsky B G, Bouhrara M, Coletta C E, Lehallier B, Urish K L, Lin P C, Goldberg I G, Spencer R G. Predicting early symptomatic osteoarthritis in the human knee using machine learning classification of magnetic resonance images from the osteoarthritis initiative. J Orthop Res 2017 [Epub ahead of print]

Hamet P, Tremblay J. Artificial intelligence in medicine. Review. Metabolism 2017; 69S: S36-S40.

Jamaludin A, Lootus M, Kadir T, Zisserman A, Urban J, Battié MC, Fairbank J, McCall I; Genodisc Consortium. ISSLS Prize in Bioengineering Science 2017: Automation of reading of radiological features from magnetic resonance images (MRIs) of the lumbar spine without human intervention is comparable with an expert radiologist. Eur Spine J 2017; 26 (5): 1374-83.

Olczak J, Fahlberg N, Maki A, Razavian AS, Jilert A, Stark A, Sköldenberg O, Gordon M. Artificial intelligence for analyzing orthopedic trauma radiographs. Acta Orthop 2017 [Epub ahead of print]

van Ginneken B . Fifty years of computer analysis in chest imaging: Rule-based, machine learning, deep learning. Review. Radiol Phys Technol 2017; 10 (1): 23-32.


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