

Abstract

Recent methodological innovations in deep learning and associated advancements in computational hardware have significantly impacted the various core subfields of quantitative medical image analysis. The generalizability, computational efficiency and open-source availability of deep learning algorithms and related software, particularly those utilizing convolutional neural networks, have produced paradigm shifts within the field. This impact is evident from topical prevalence in the literature, conference and workshop themes and winning methodologies in relevant competitions. In this work, we review the various state-of-the-art approaches to learning and prediction and/or optimizing image transformations using convolutional neural networks. Although of primary importance within the quantitative imaging domain, image registration algorithmic development, in the context of these deep learning strategies, has received comparatively less attention than its counterparts (e.g., image segmentation). Nevertheless, significant progress has been made in this particular subfield which has been presented in various research venues. We contextualize these contributions within the broader scope of deep learning advancements and, in so doing, attempt to facilitate the leveraging and further development of such techniques within the medical imaging research community.

Key words: convnets, deep learning, diffeomorphisms, image registration, spatial normalization