Find the differences: lesion changes analysis in longitudinal imaging studies by simultaneous deep learning

Prof. Leo Joskowicz

Director, CASMIP Laboratory

School of Computer Science and Engineering, The Hebrew University

Follow-up of patients using radiological images, e.g., CT, MRI, OCT scans acquired every few month is routinely used for assessing disease progression, treatment response, and for adjusting management strategies. Longitudinal study interpretation differs from diagnostic reading in that the focus is on detecting and measuring changes between scans rather than identifying abnormalities in a single scan. This process is complex and time-intensive, as it requires identifying, matching and tracking several lesions in unregistered scans, classifying and quantifying their differences, and detecting patterns of change. Despite advances in AI and deep learning for single-scan analysis, current methods do not adequately address the challenges of radiological follow-up.

In this talk, we present a comprehensive framework for automated detection and measurement of lesion changes in longitudinal volumetric imaging studies. It is based on the simultaneous analysis of pairs of prior and current scans of a patient with a four-step pipeline consisting of: 1) registering scans within the region of interest; 2) concurrently detecting and segmenting lesions; 3) analyzing and classifying lesion changes; and 4) quantifying these changes. We showcase our framework through applications in analyzing tumor progression in liver CT and PET-CT scans, lung CT scans, brain MRI scans, and assessing retinal eye atrophy in OCT scans for age-related macular degeneration. Experimental studies demonstrate that our simultaneous analysis methods outperform standalone approaches, establishing state-of the-art results.

Short Bio

Leo Joskowicz is the founder and director of the Computer-Aided Surgery and Medical Image Processing Laboratory (CASMIP Lab). He is a Fellow of the IEEE, ASME, and MICCAI (Medical Image Computing and Computer Assisted Intervention) Societies. Prof. Joskowicz served as President of the MICCAI Society and as Secretary General of both the International Society of Computer Aided Orthopaedic Surgery (CAOS International) and the International Society for Computer Assisted Surgery (ISCAS). He was honored with the 2010 Maurice E. Muller Award for Excellence in Computer Assisted Surgery by CAOS International and the 2007 Kaye Innovation Award. He has published 300 technical works including books, journal papers, book chapters, and editorials, and has 14 issued patents. Prof. Joskowicz contributes to the Editorial Boards of Medical Image Analysis, Int. J. of Computer Aided Surgery, and Computer Aided Surgery, and has been involved in numerous program committees. He co-founded HighRAD, a company specializing in oncology AI imaging with FDA-cleared products.