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6:00AM - 3:00PM
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A pipeline for detecting new multiple sclerosis lesions on longitudinal brain magnetic resonance imaging

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Purpose
To develop an automated approach to detect new multiple sclerosis (MS) lesions from longitudinal brain MR images. The goal is to reduce user interaction and provide an objective tool to eliminate inter- and intra-observer variability. This tool could help to predict conversion to MS from a clinically isolated syndrome and improve patient monitoring, providing new robust and automatic biomarkers for disease evolution.
Materials and Methods
A cohort of 35 patients with new lesions scanned with a 3T Siemens Trio machine has been used to evaluate the results. The new lesion volume for all patients ranges between 12.53 and 7563.08 mm3 with a mean of 80.58 mm3 and 5 new lesions per patient. The new pipeline, which relies on 3D subtraction, introduces a novel postprocessing approach based on deformation fields computed using the Demons nonrigid registration algorithm. The full pipeline includes several steps: skull stripping, bias correction, intrasubject normalization, registration (both rigid and nonrigid) between baseline and follow-up images, a tissue segmentation step on both time points, a 3D subtraction, and automated thresholding to obtain an initial positive activity mask and a final postprocessing step that combines rules based on intensity, lesion size and deformation fields to reduce the number of false positives.
Results
Evaluation with expert annotations of new appearing lesions provided by expert radiologists was performed. The following values were obtained: 71% of true positive (TP) fraction and 18% of false positive (FP) fraction, with a mean detection of three new lesions per patient.
Conclusions
Promising new MS lesion segmentation results have been obtained in terms of detection. Our novel approach highly reduces the number of FP providing a good correlation in terms of detection between manual annotations (current standard) and the automatic detection.