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CRC In vivo Imaging

Lesioned brain images: Segmentation and normalization

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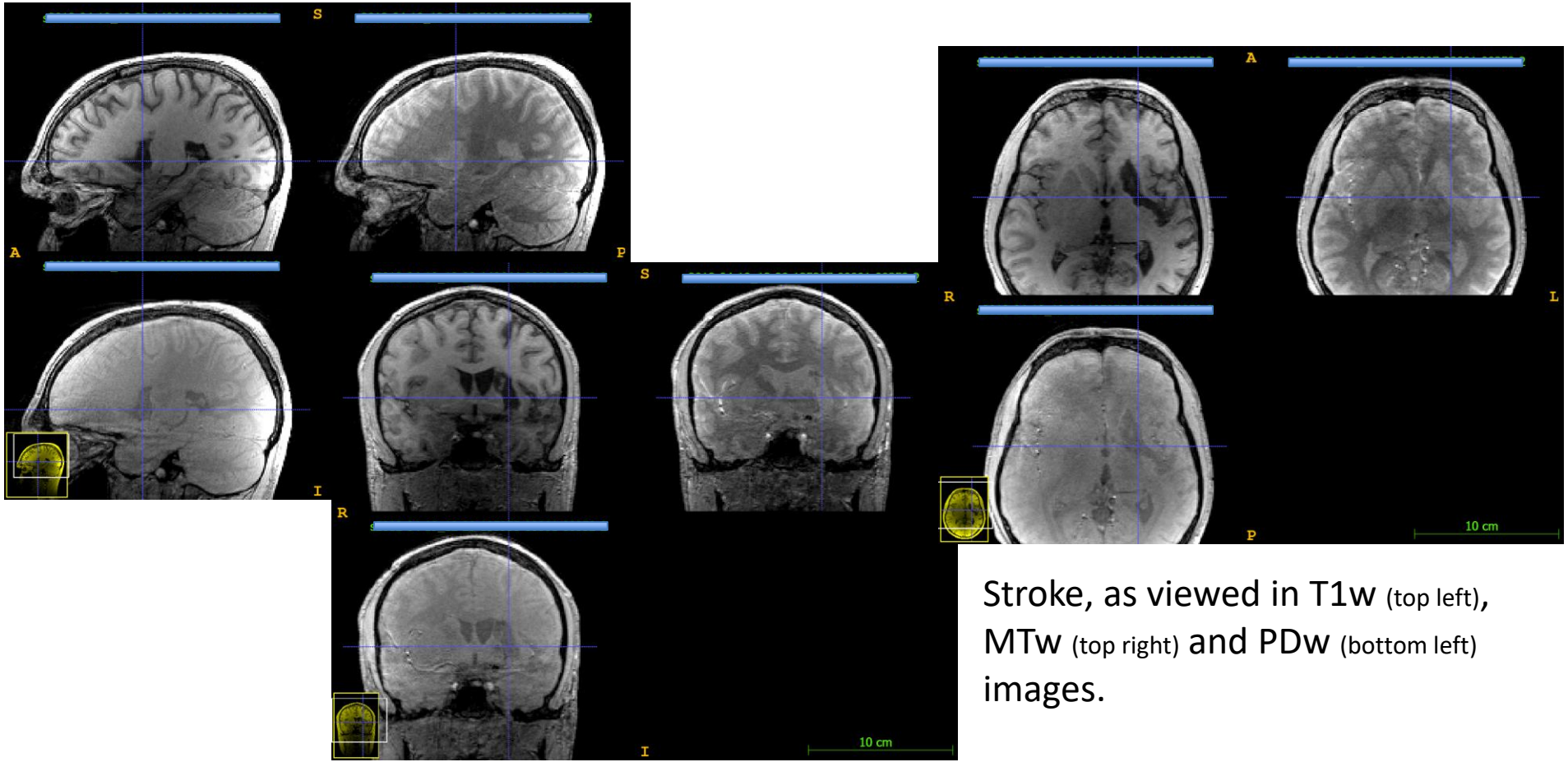
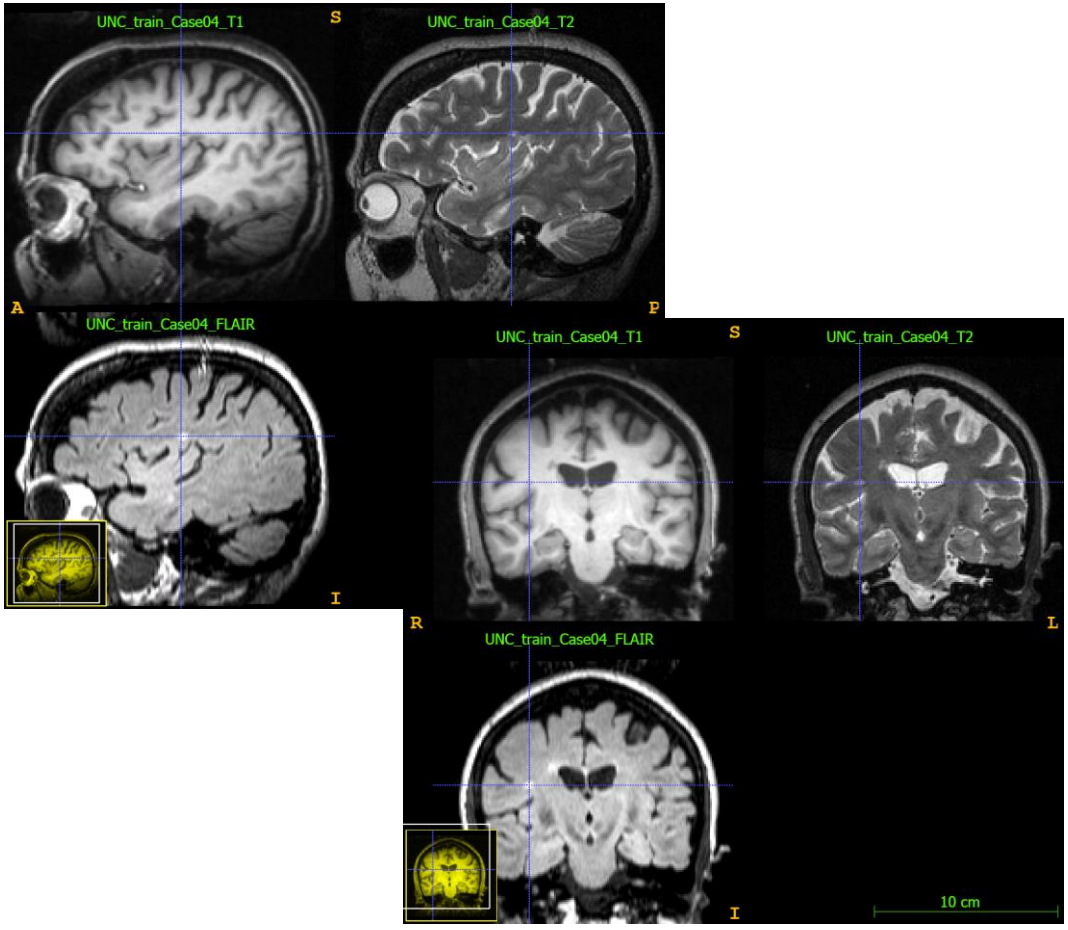
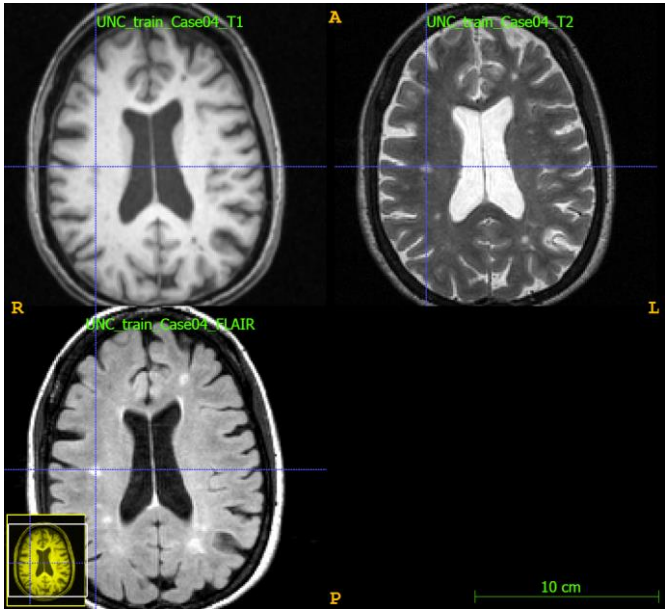
Brain MRIs with “lesions”: stroke



Stroke, as viewed in T1w (top left), MTw (top right) and PDw (bottom left) images.

Brain MRIs with “lesions”: multiple sclerosis





Multiple sclerosis, as viewed in T1w (top left), T2w (top right) and FLAIR (bottom left) images.

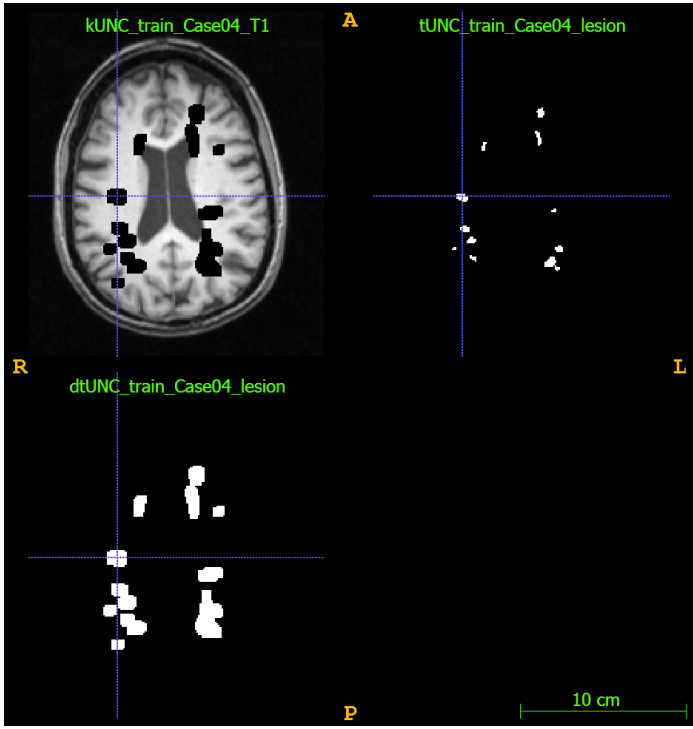
Normalization and segmentation?

"Cost Function Masking"

- easy to apply
- provides normalization of healthy tissues

BUT

- Segmentation only in not-masked part
- if large lesion(s), global effect of normalization?
- **need a mask of lesion area(s)**



Multiple sclerosis: T1w (top left), lesion mask (top right) and dilated lesion mask (bottom left) images.

Lesion mask generation, manual vs automatic

Manual

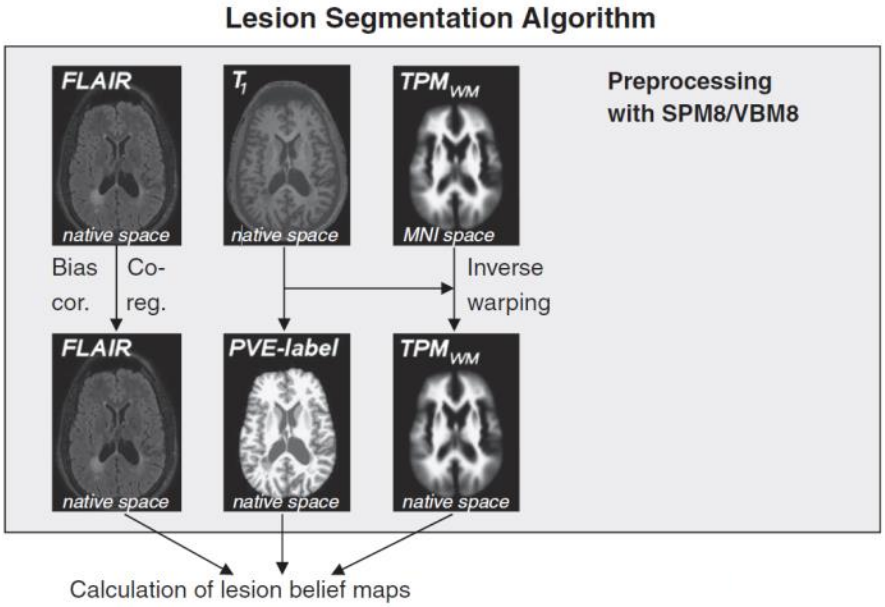
- Time consuming & subjective
- Inter-rater variability and error prone

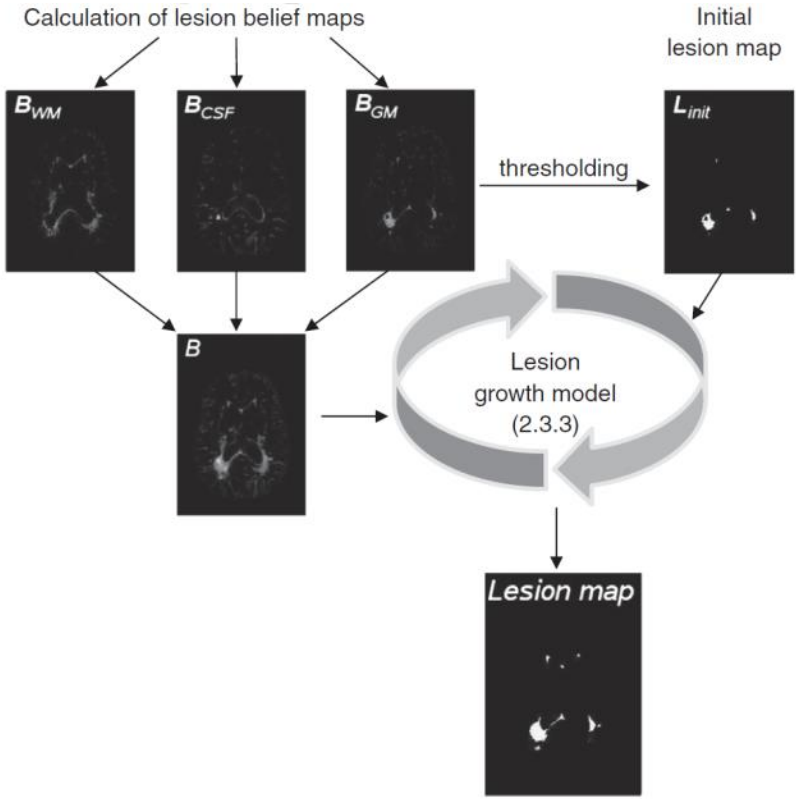
Automatic

- Faster & reproducible
- But how?
  - Specific sequences
  - Specific applications
  - Specific tools (ML, adaptative thresholding,…)

Lesion mask generation

Automatic mask generation based on T1w and FLAIR images (Schmidt et al. 2012)
→ Lesion mask in subject space.





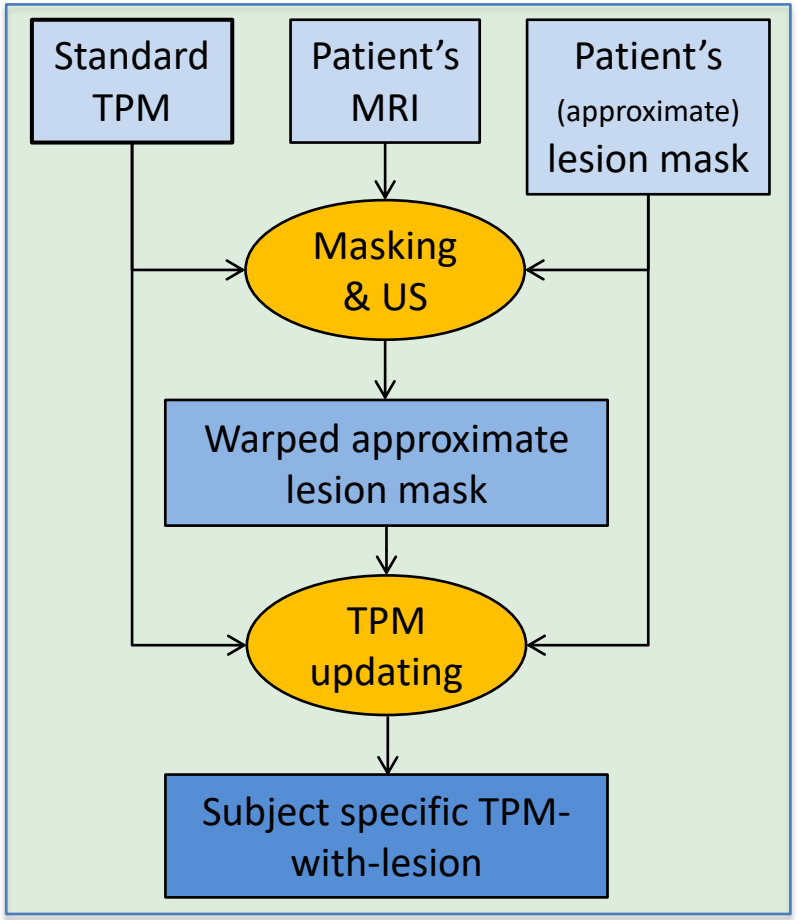
Unified segmentation with lesion

US-with-Lesion extend

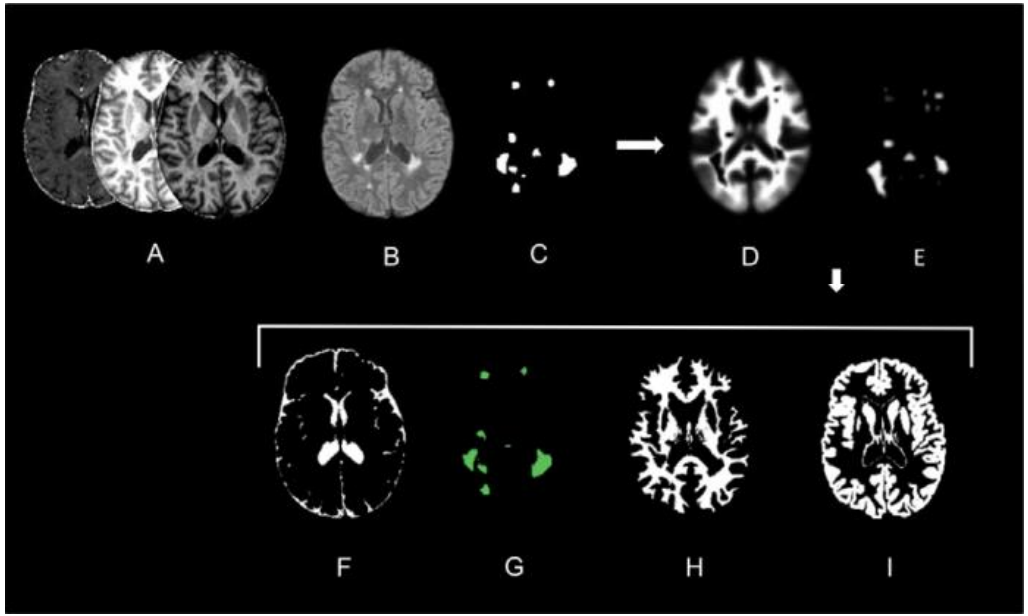
1. TPM with lesion tissue class
2. apply US with new extTPM

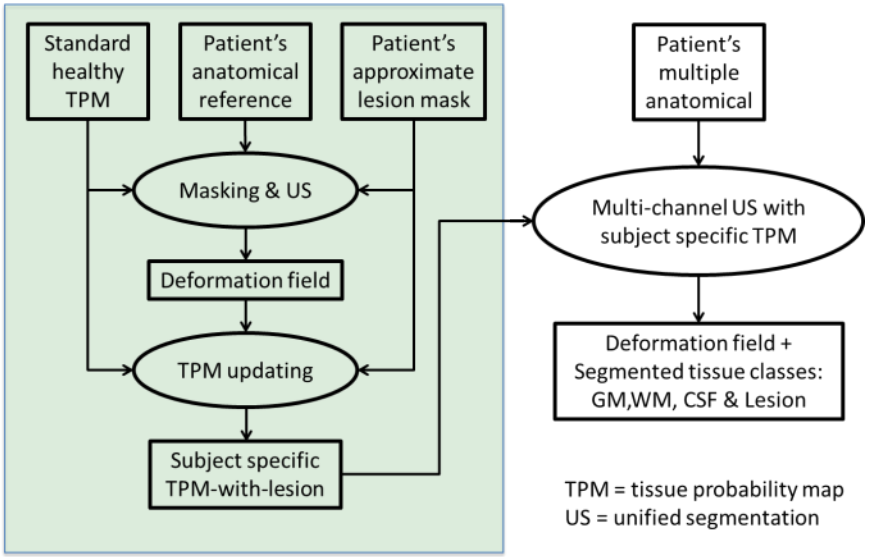
Key points:

- needs a prior lesion mask
- accounts for lesion + healthy tissues by extending TPMs
- provides normalization and segmentation



USwL for MS image segmentation & warping



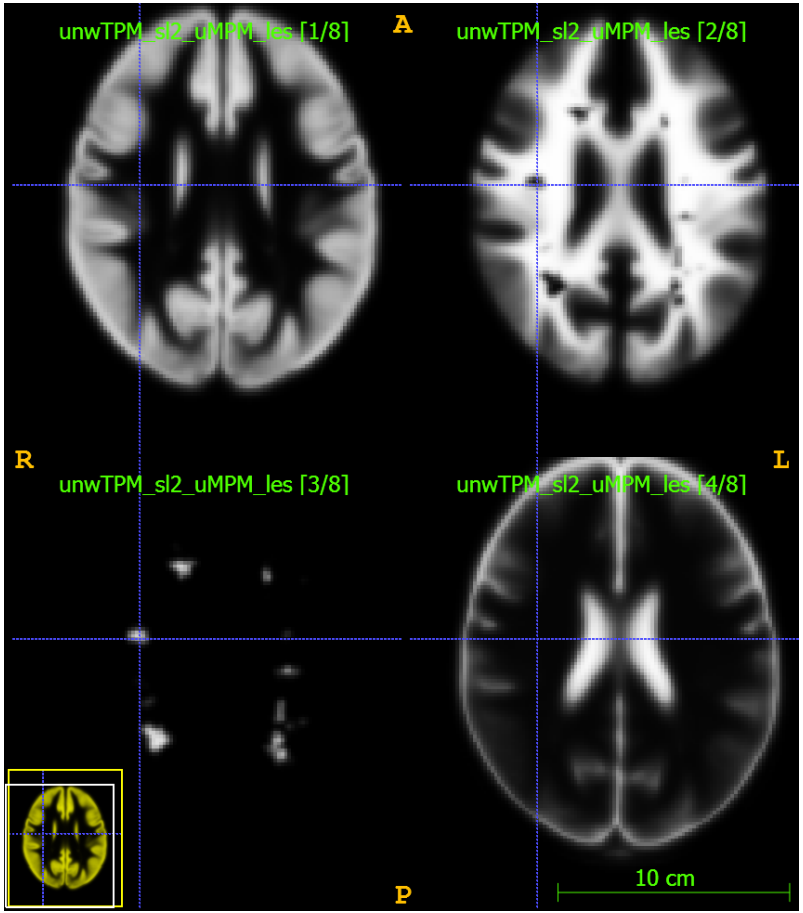


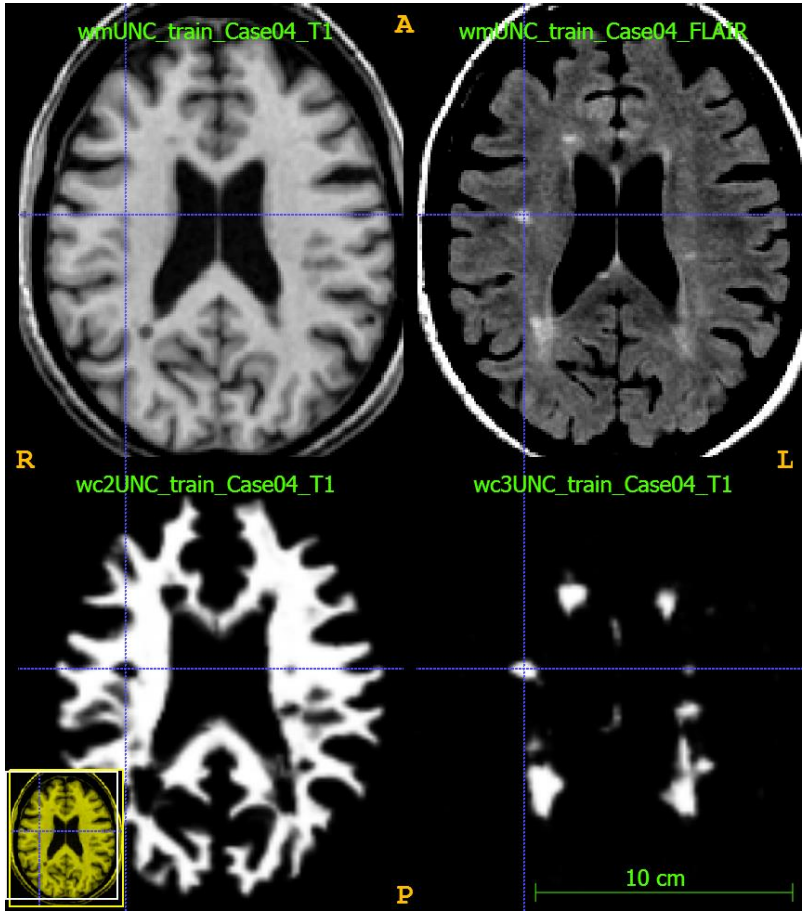
Key features of "Unified Segmentation with Lesion"

1. More principled segmentation and normalisation approach for lesioned brain
2. Increased sensitivity, from multichannel qMRI segmentation, wrt. FLAIR hyper-intensity lesion detection

Phillips *et al.*, https://github.com/CyclotronResearchCentre/USwLesion

US-with-Lesion results





References

- M. Brett et al. (2001), ‘Spatial normalization of brain images with focal lesions using cost function masking’, NeuroImage, 14:486–500.
- P. Schmidt et al. (2012), ‘An automated tool for detection of FLAIR-hyperintense white-matter lesions in Multiple Sclerosis’, NeuroImage, 59(4): 3774–3783.
- Phillips et al. (2017), https://github.com/CyclotronResearchCentre/USwLesion

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Thank you for your attention!


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Normalization and segmentation?