

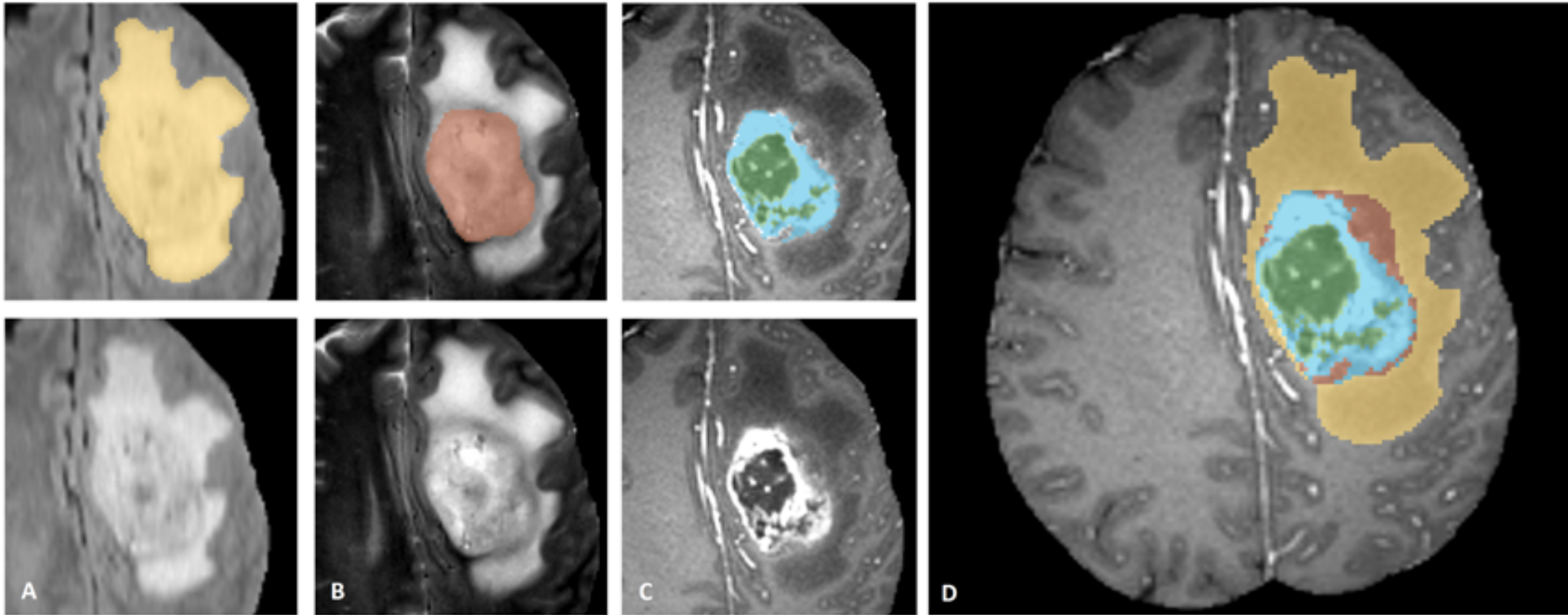
BRATS 2013

Tumor Segmentation

Challenge

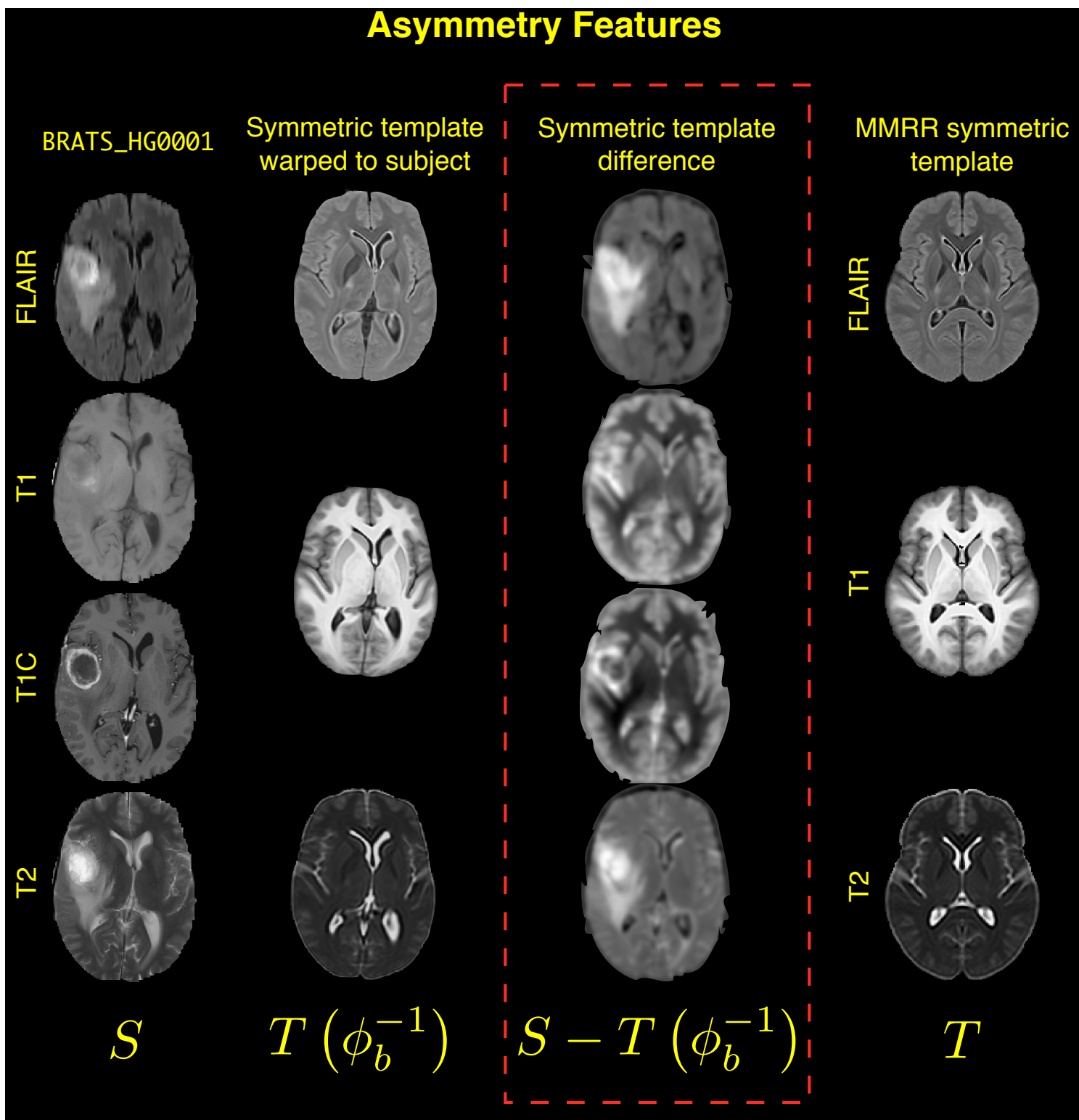
Example 5

Multivariate Tumor Segmentation

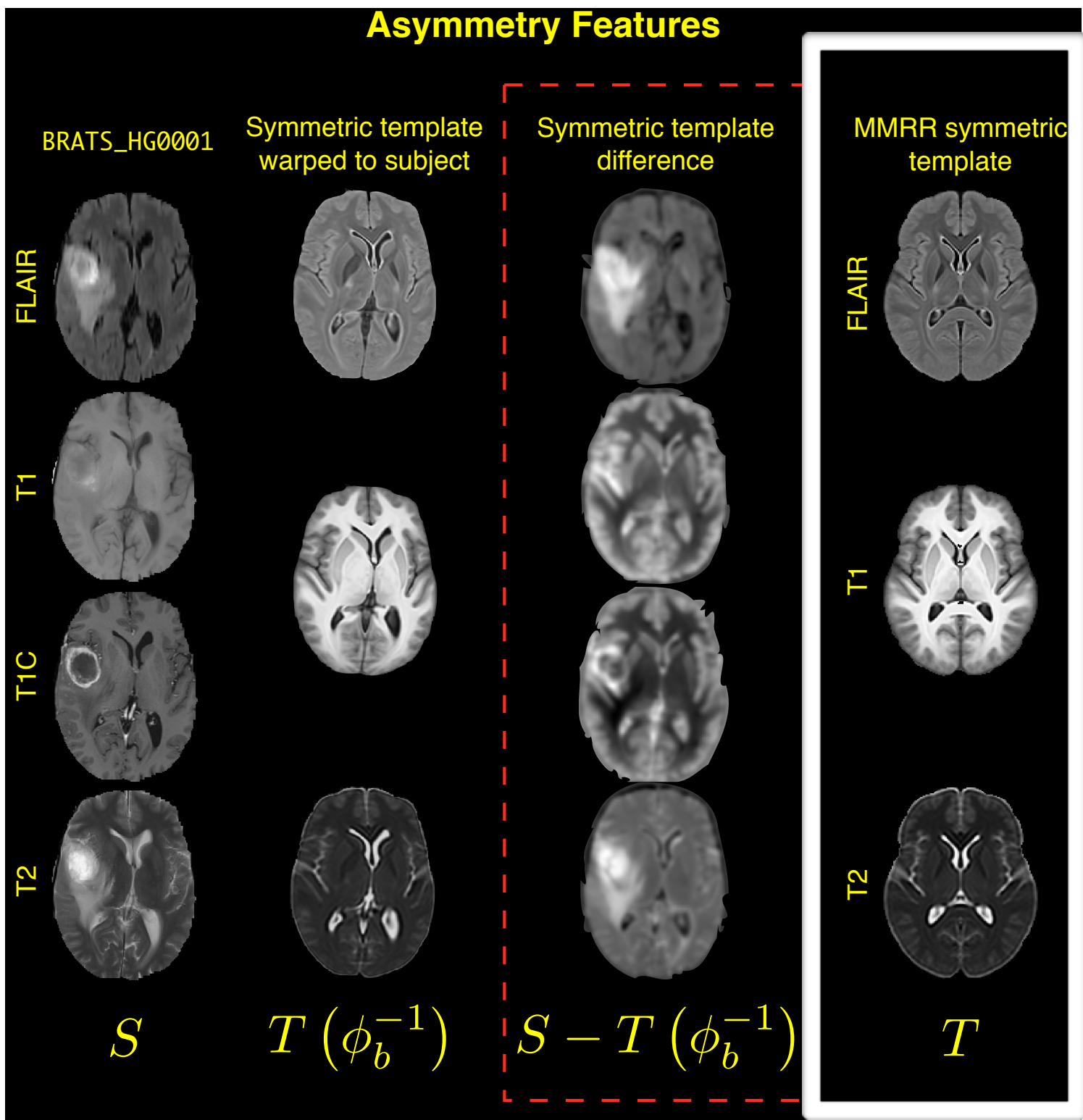


ual annotation through expert raters. Shown are image patches with the tumor structures that are annotated in the different modalities for the whole dataset (right). The image patches show from left to right: the *whole* tumor visible in FLAIR (A), the tumor enhancing *active* tumor visible in T1c (blue), surrounding the cystic/necrotic components of the core (green) (C). The segmentation labels (D): edema (yellow), non-enhancing solid core (red), active core (blue), non-solid core (green).

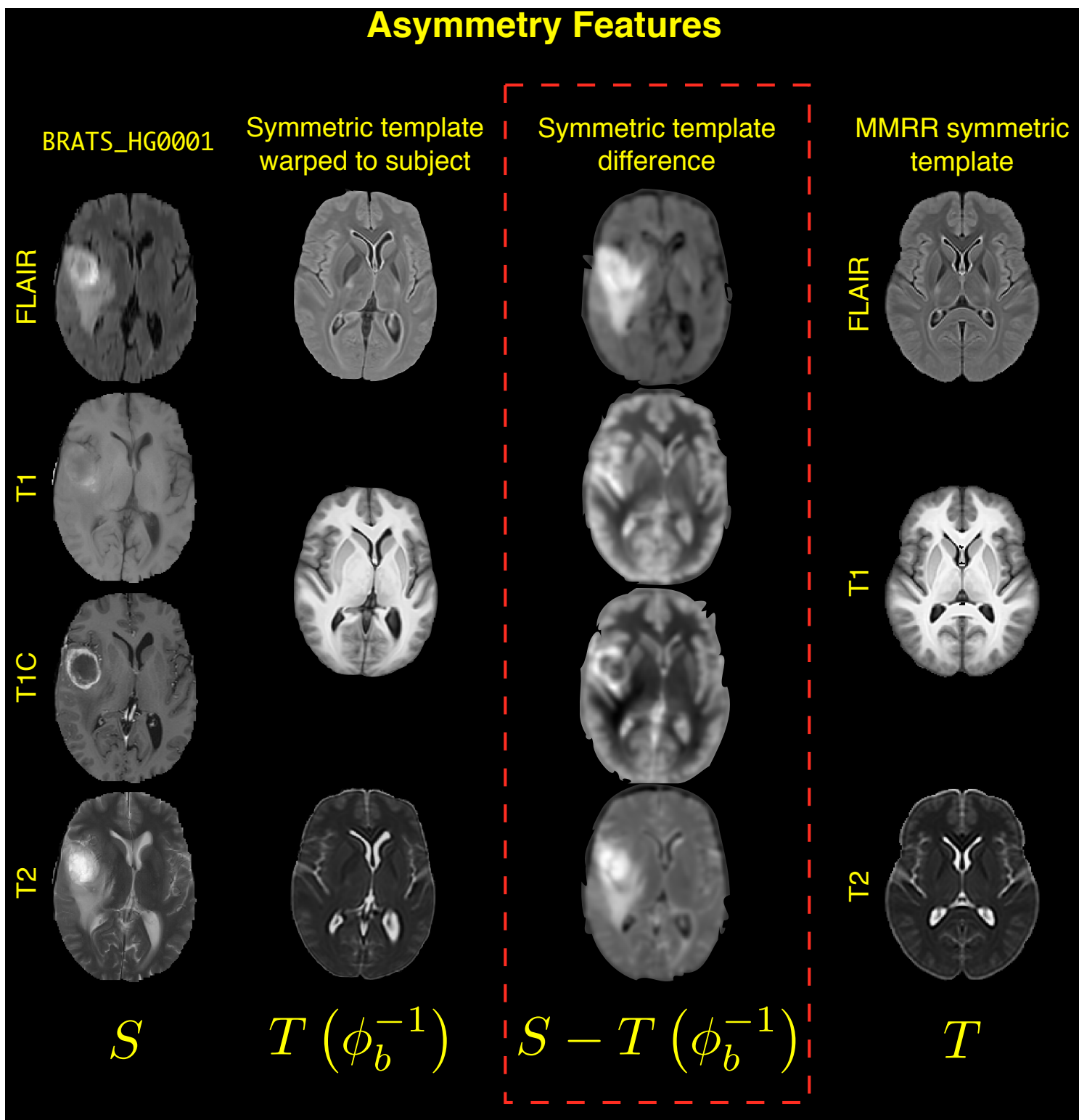
BRATS 2013 ANTsR Features



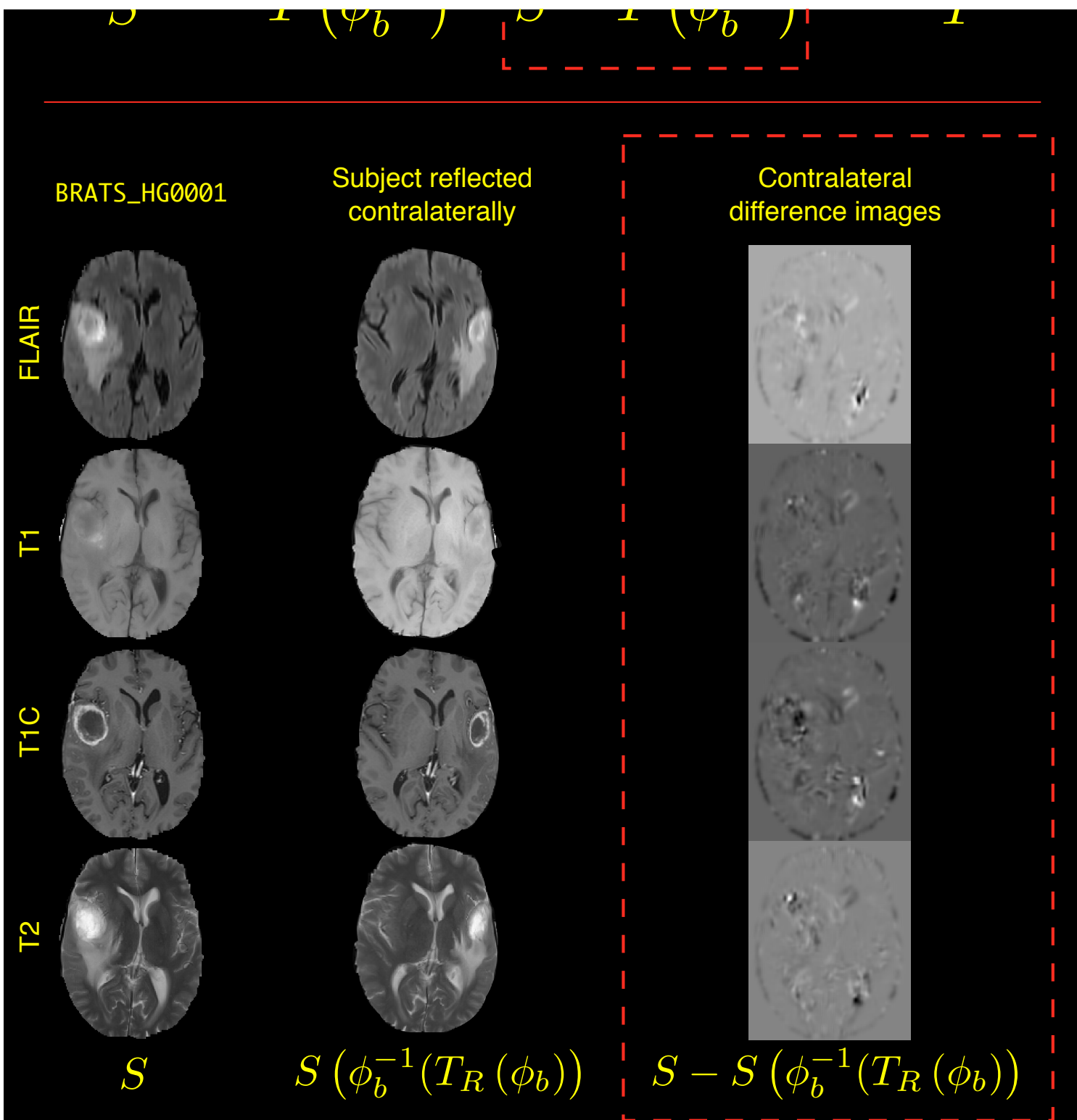
BRATS 2013 ANTsR Features



BRATS 2013 ANTsR Features

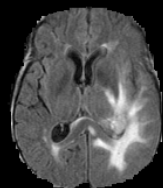


BRATS 2013 ANTsR Features

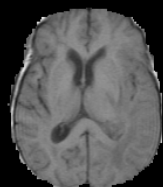


BRATS 2013 *ANTsR* Pipeline

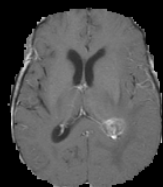
Multi-modal input



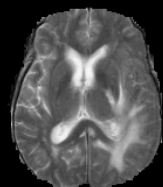
FLAIR



T1



T1C

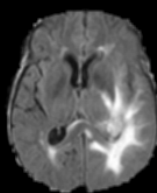


T2

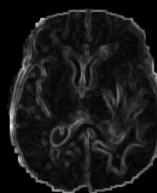
BRATS_HG0301

Neighborhood statistical images

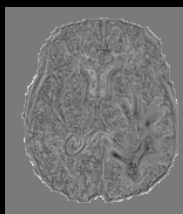
(Radius = 1)



Mean

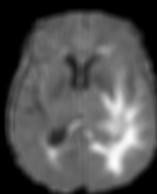


Standard deviation

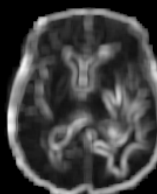


Skewness

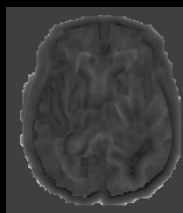
(Radius = 3)



Mean

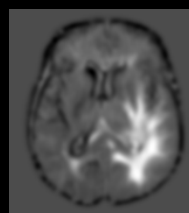


Standard deviation

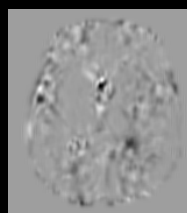


Skewness

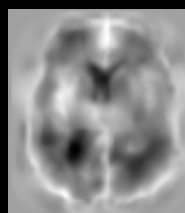
Symmetric template-based



Template difference

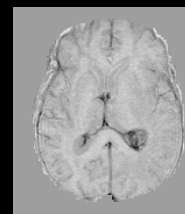


Contralateral difference

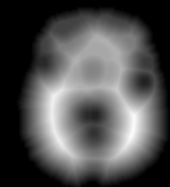


Log Jacobian

Miscellaneous



T1-T1C difference

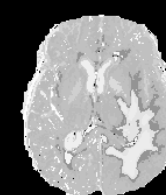
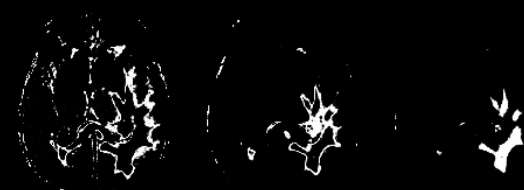


Normalized distance

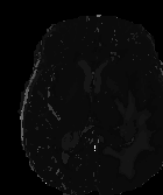
GMM or MAP-MRF derived



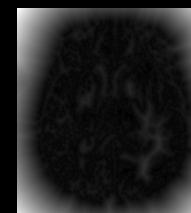
Atropos posteriors ($n = 7$ classes)



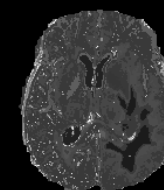
Eccentricity



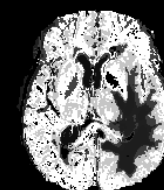
Elongation



Tumor core distance



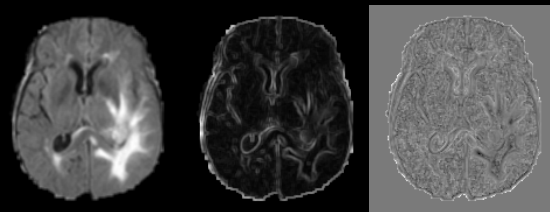
Volume/
surface area



Physical volume

BRATS 2013 *ANTsR* Pipeline

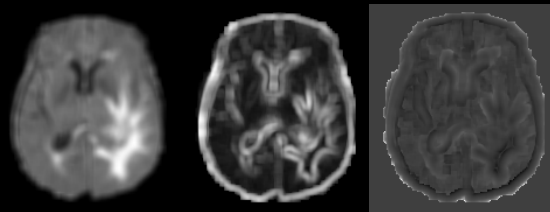
Neighborhood statistical images



Mean

Standard deviation

Skewness

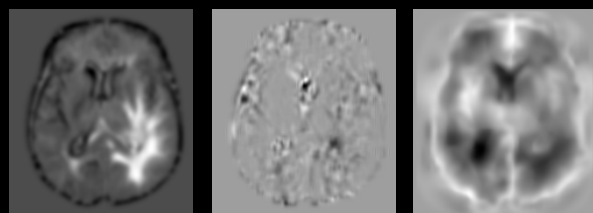


Mean

Standard deviation

Skewness

Symmetric template-based

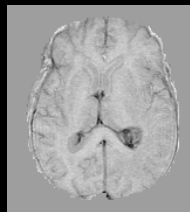


Template difference

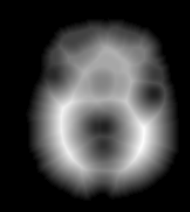
Contralateral difference

Log Jacobian

Miscellaneous

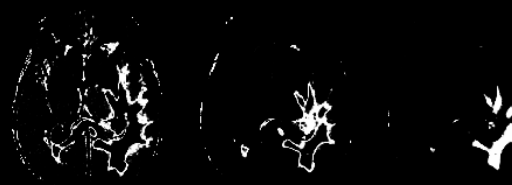


T1-T1C difference

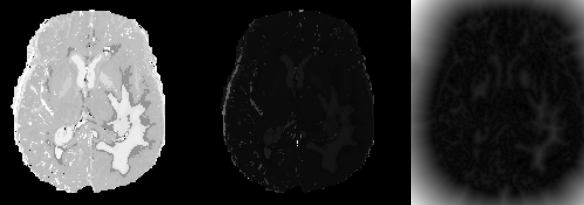


Normalized distance

GMM or MAP-MRF derived



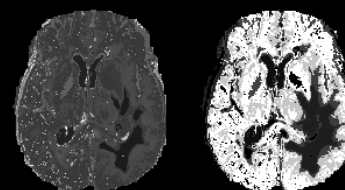
Atropos posteriors ($n = 7$ classes)



Eccentricity

Elongation

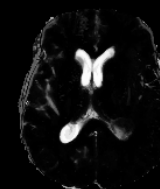
Tumor core distance



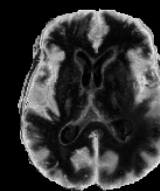
Volume/surface area

Physical volume

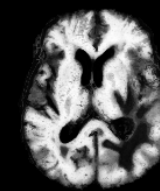
RF voting output



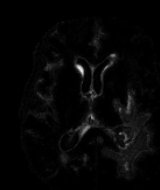
CSF



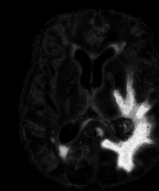
Gray matter



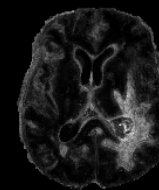
White matter



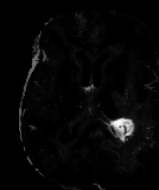
Necrosis



Edema



Non-enhancing

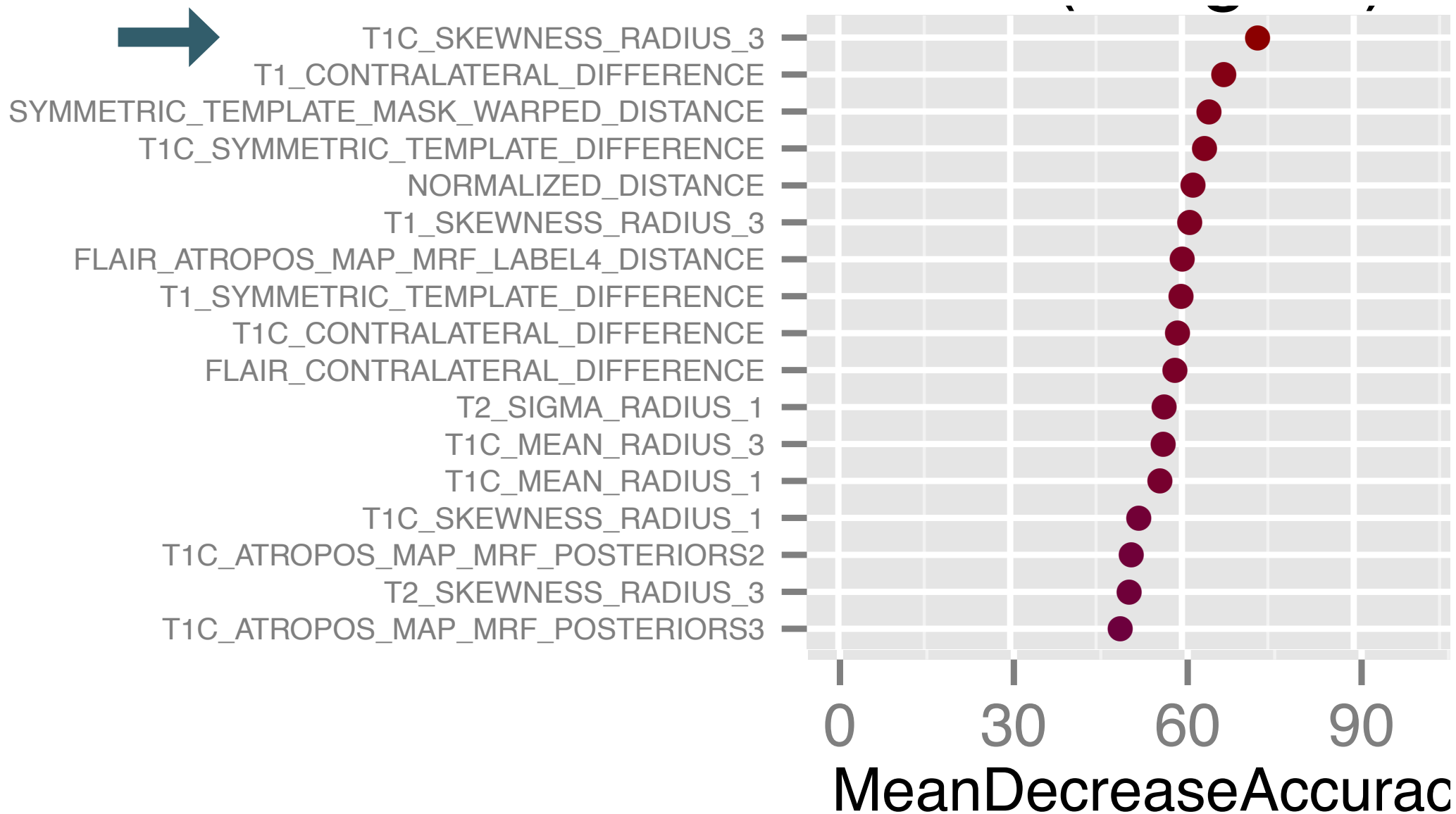


Enhancing

Multiple Modality Feature Importance



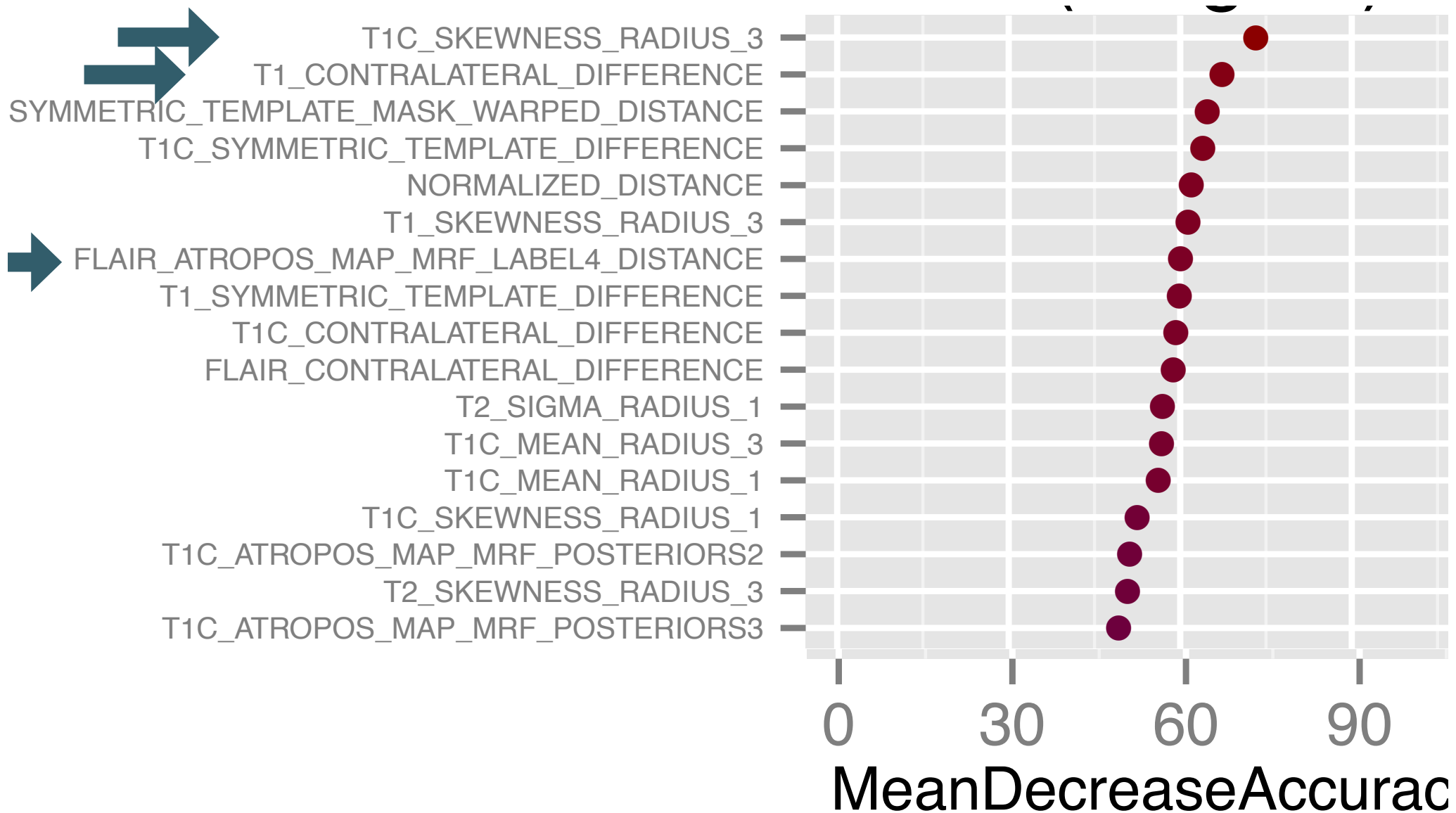
Multiple Modality Feature Importance



Multiple Modality Feature Importance



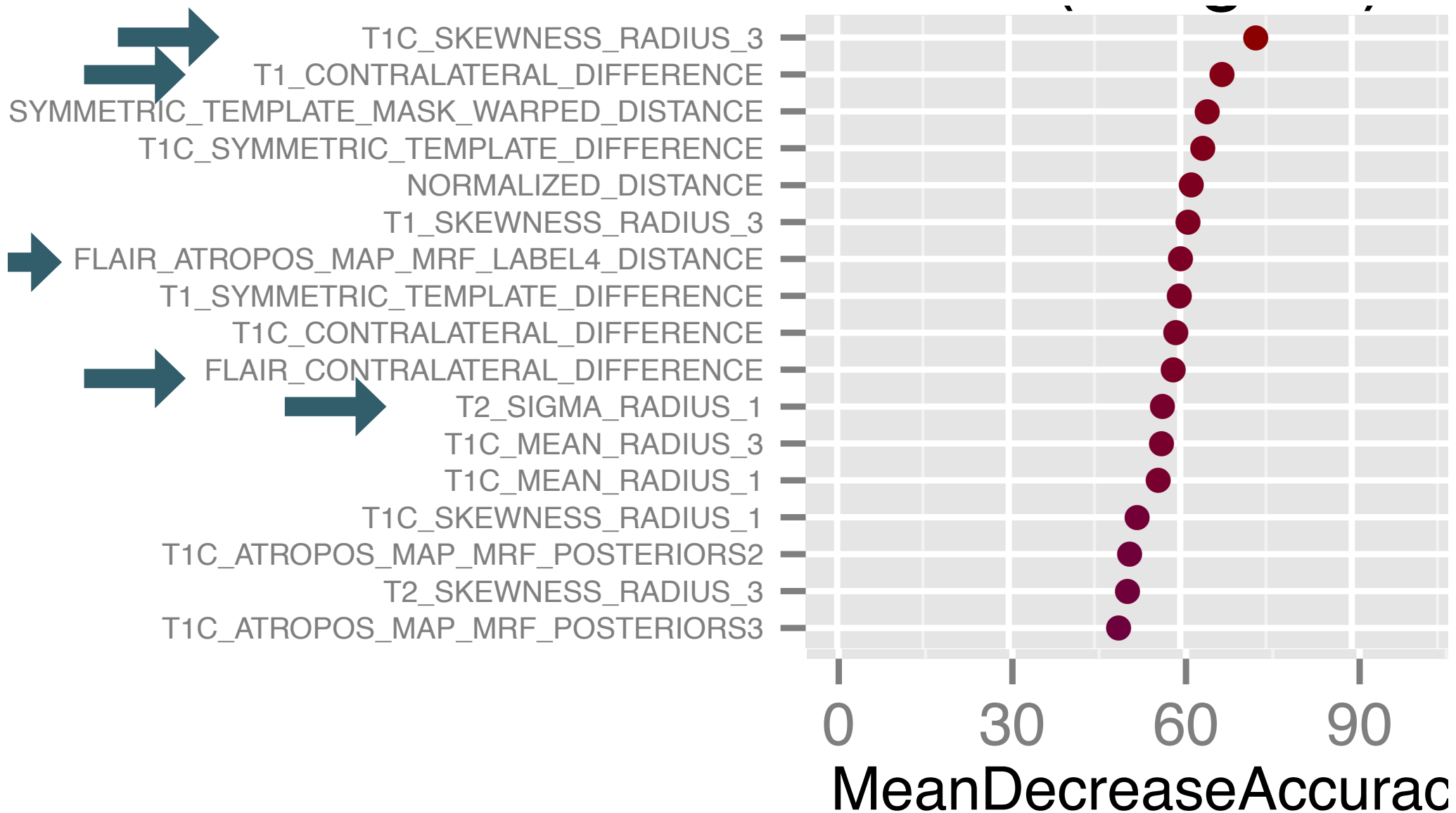
Multiple Modality Feature Importance

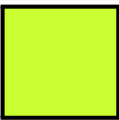
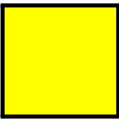

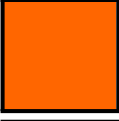





Multiple Modality Feature Importance



Multiple Modality Feature Importance



| BRATS 2013 | | | | |
|---|-----------|----------------|----------------|-----------|
| Real data | | whole | core | active |
| Dice (in %) | | <i>HG only</i> | <i>HG only</i> | |
|  | Cordier | 84 | 68 | 65 |
|  | Doyle | 71 | 46 | 52 |
|  | Festa | 72 | 66 | 67 |
|  | Meier | 82 | 73 | 69 |
|  | Reza | 83 | 72 | 72 |
|  | Tustison | <u>87</u> | <u>78</u> | <u>74</u> |
|  | Zhao (II) | 84 | 70 | 65 |

MICCAI BRATS Workshop
presents the 2013 “certificate of awesomeness”

1st Place Award

to

Nick Tustison

for

the top-performing multi-modal brain tumor
segmentation algorithm

Presented on September 22, 2013

[Bruce Lee]

[Barak H. Obama]

Only competitors

**Only competitors
to release their solution:**

**Only competitors
to release their solution:**

**Only competitors
to release their solution:**

**[https://github.com/
ntustison/BRATS2013](https://github.com/ntustison/BRATS2013)**