Die fette Katze wird immer fetter:
New tracking and interactive tools in AFNI-FATCAT

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Functional And Tractographic Connectivity Analysis Toolbox[1]

- For functional and structural connectivity
  - » Quantitative analyses
  - » Combined viewing, tracking, and InstaCorring in AFNI[2] and SUMA[3].

Recent FATCAT additions:

- **HARDI** tracking
- Enhance deterministic tracking → **mini-probabilistic**
- **(Multimodal) Interactive investigation** in SUMA

1) HARDI TRACKING

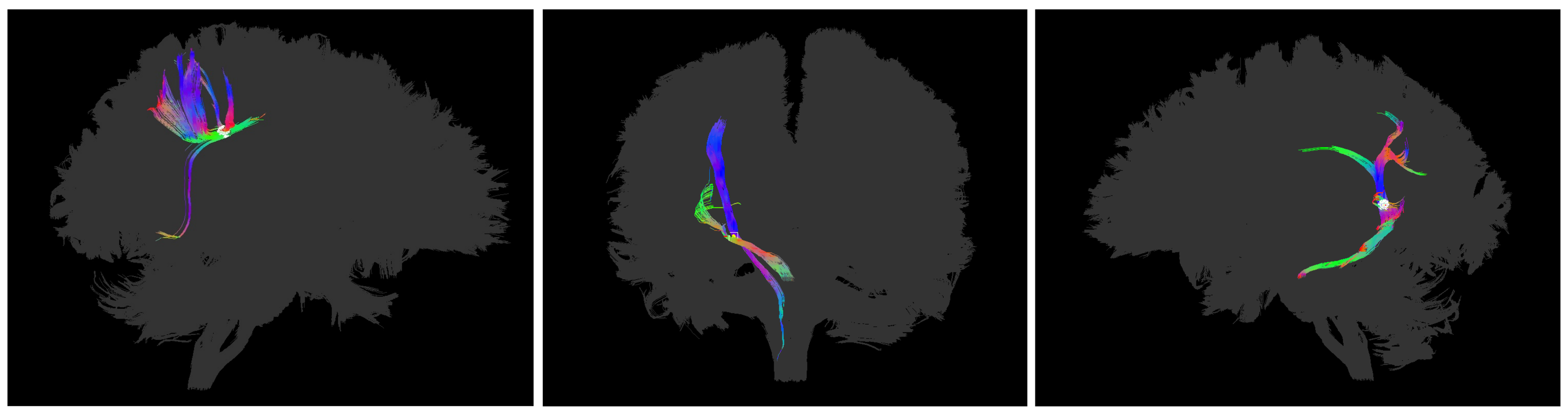
The problem: Underlying WM tract structure is complicated:

- many voxels contain multiple fiber bundles and trajectories
- to a tensor model, complex structures look like low-FA gray matter.

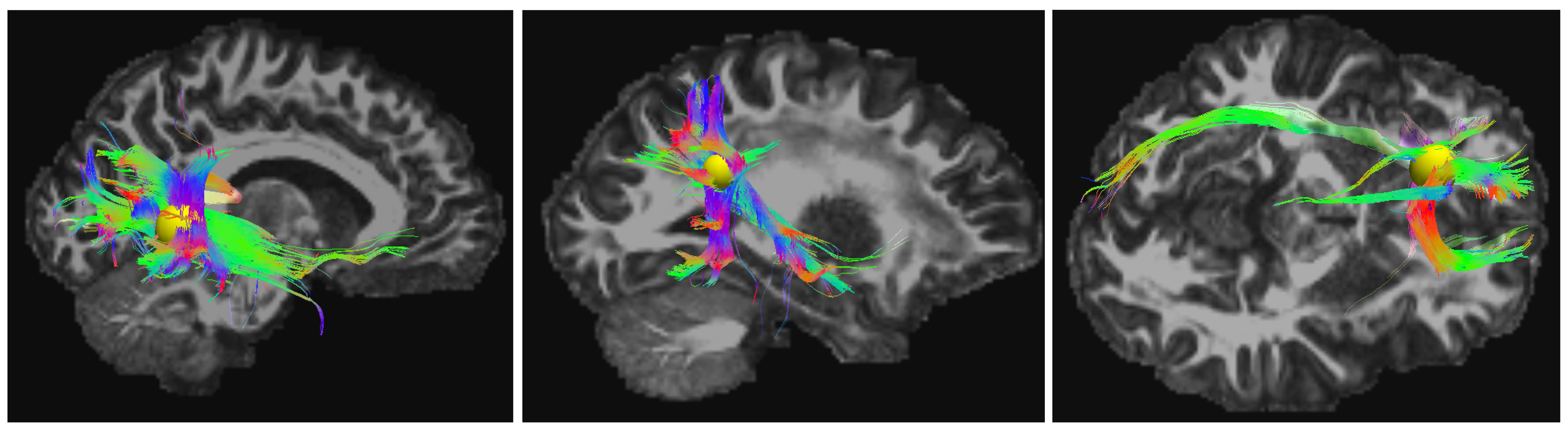
The solution: HARDI-based multi-tracking is now available in FATCAT.

- still fast and can simultaneously analyze multiple networks.
- HARDI reconstruction via Diffusion Toolkit[4], DSI Studio[5], Dipy[6], etc.
- tracking: deterministic, mini-probabilistc (below) or full probabilistic.

Examples: Human Connectome Project[7] data.



Multiple fiber pathways through small volume (1-2 mm diameter sphere).



Complicated tract structures through given target ROIs (yellow). Tracts more easily propagate over long distances without termination in white matter that would have low-FA values in DTI modeling.

2) MINI-PROBABILISTIC TRACKING

The problem: noise gets into both DTI and HARDI fits.

- deterministic tracking ignores these uncertainties
  - » susceptibility to error accumulation
- probabilistic tracking accounts for model uncertainty
  - » slow
  - » generates voxel maps without linear tracts.

The solution: **new 'mini-probabilistic' tracking**

- **includes voxelwise uncertainty**
- ***and* retains tract structure (Fig. 1)**
  - » **more robust** and **fewer false negatives** than deterministic
  - » false positives tend to be isolated/obvious
  - » fast

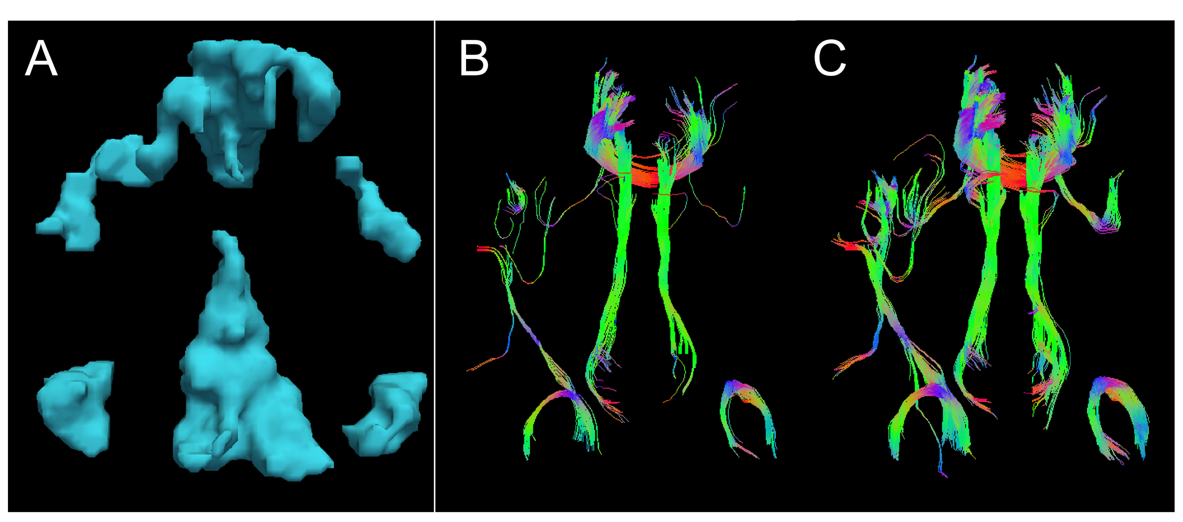


Figure 1: *For the GM ROIs in (A), (B) shows deterministic AND-logic tracts, while the new "mini-probabilistic" option is used in (C). Note the greater extent and robustness of many bundles in (C).*

3) INTERACTIVE INVESTIGATION

The problem: complicated data sets

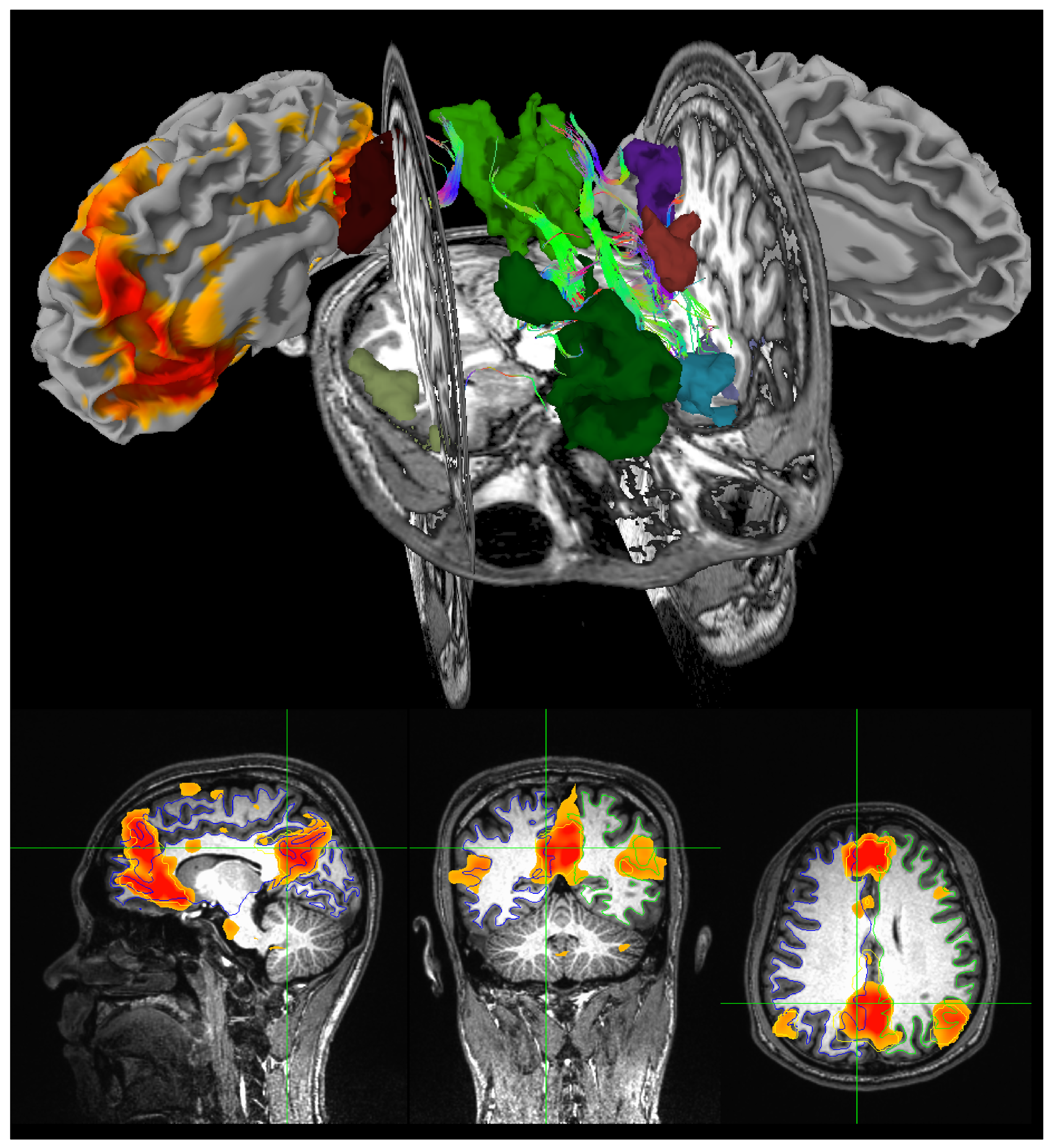
- many networks (motor, executive control, default mode, etc.)
- many modalities (FMRI, DTI, anatomical, etc.):
- how to synthesize, view, combine, explore?

The solution: AFNI + SUMA + FATCAT

- able to generate anatomical and functional connectivity simultaneously
  - » AFNI's InstaCorr for functional correlation
  - » SUMA renders tracts, surfaces, volumes, and graphs

Examples: Human Connectome Project[6] data.

Simultaneous viewing of tracts and target GM ROIs in SUMA and AFNI.



Simultaneous viewing of tract, target ROIs, InstaCorr-elation and structure with FATCAT, SUMA and AFNI.

CONCLUSIONS

- FATCAT is freely available as part of AFNI
  - » Includes a set of descriptive example scripts and demo data
- Mini-probabilistic tracking provides benefits over standard deterministic
  - » fast and easy to implement
- AFNI and SUMA facilitate data interaction
  - » Multimodal viewing and calculation simultaneously
  - » This is important for **both research and clinical** usage
- HARDI tracking now available
  - » User suggestions for more features are always welcomed.

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