

SVReg Hands On Training

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[HTTP://BRAINSUITE.ORG/PROCESSING/SVREG/](http://BRAINSUITE.ORG/PROCESSING/SVREG/)



SVReg Overview

Registers subject to atlas template

- Uses surface and volume information

Novel feature:

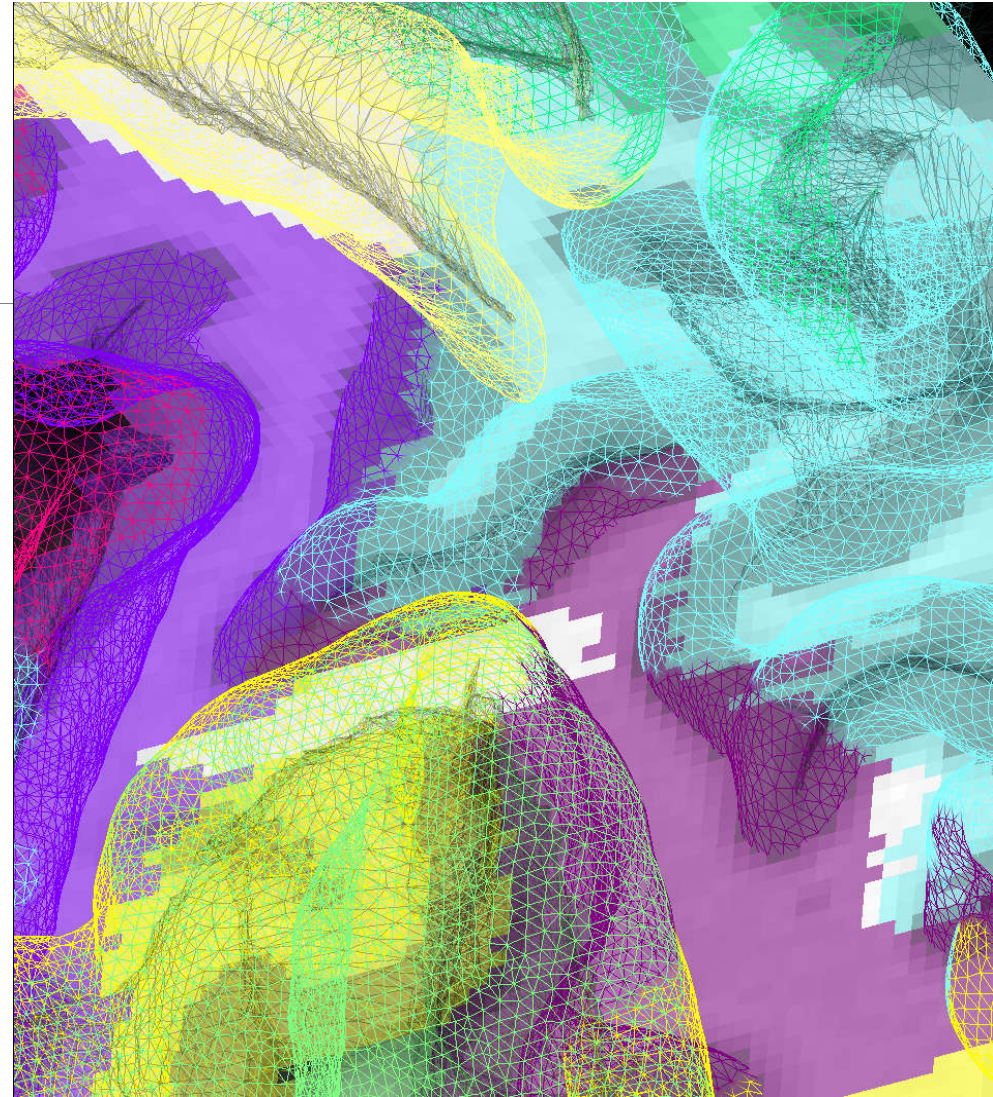
- Surface & Volume has a 1 to 1 correspondence

Package materials

- 2 atlases
- Command line tools

SVReg Directory

Windows	C:\Program Files\BrainSuite15c\svreg
Mac	/Applications/BrainSuite15c/svreg



BrainSuiteAtlas1

Where to find it

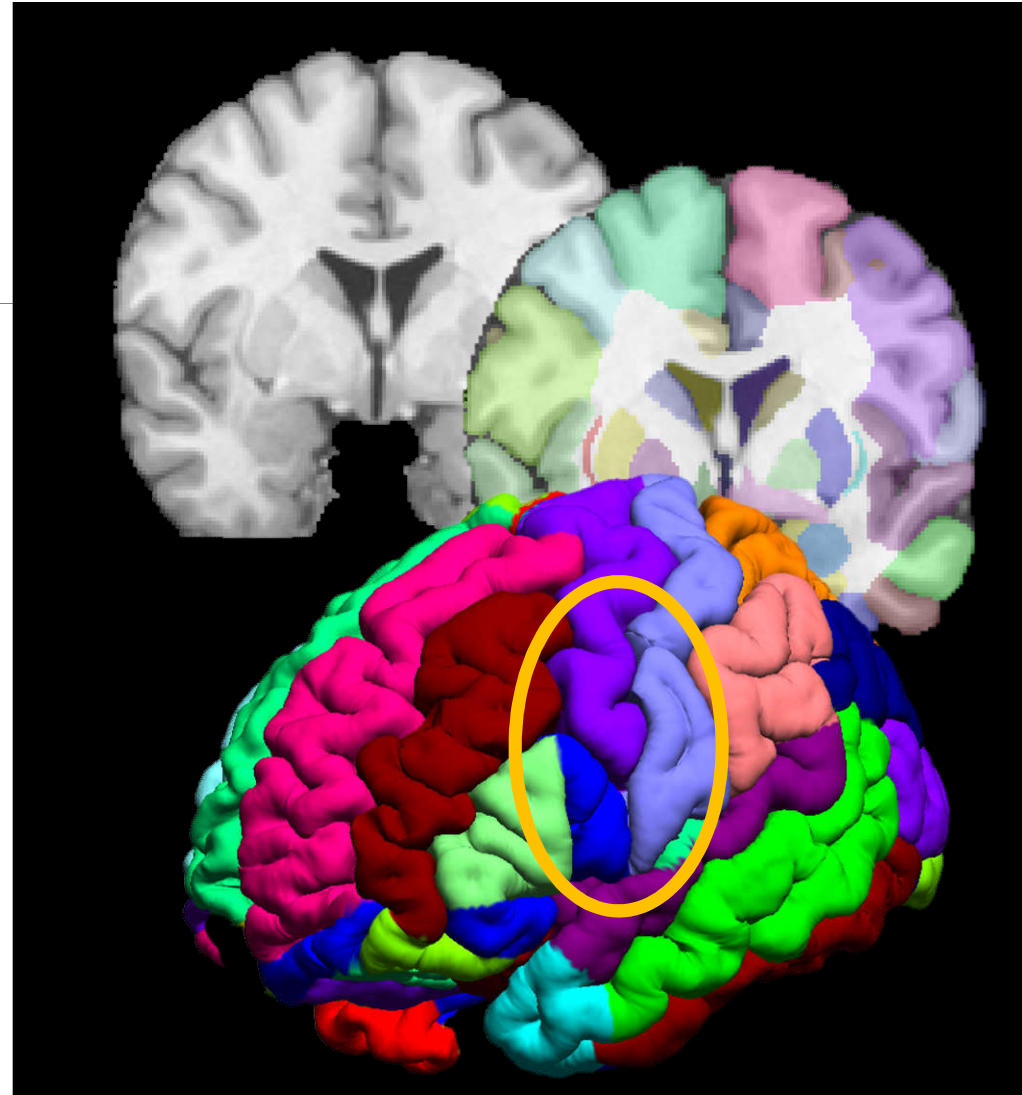
- <SVReg-dir>\BrainSuiteAtlas1

Specs

- Typical Resolution— $1 \times 1 \times 1 \text{ mm}^3$ isotropic
- 1.5T field strength
- High SNR—averaged 27 scans of 1 individual
- Distributed in 1998

Uncommon anatomical anomaly

- Left precentral gyrus
- Systematic issue for registration



BCI-DNI Atlas

Where to find it

- <SVReg-dir>\BCI-DNI_brain

High Resolution and High tissue contrast

- 0.5 x 0.5 x 0.8 mm
- 3T Seimens
- 3D-T1 weighted
- Finer anatomic detail for better registration

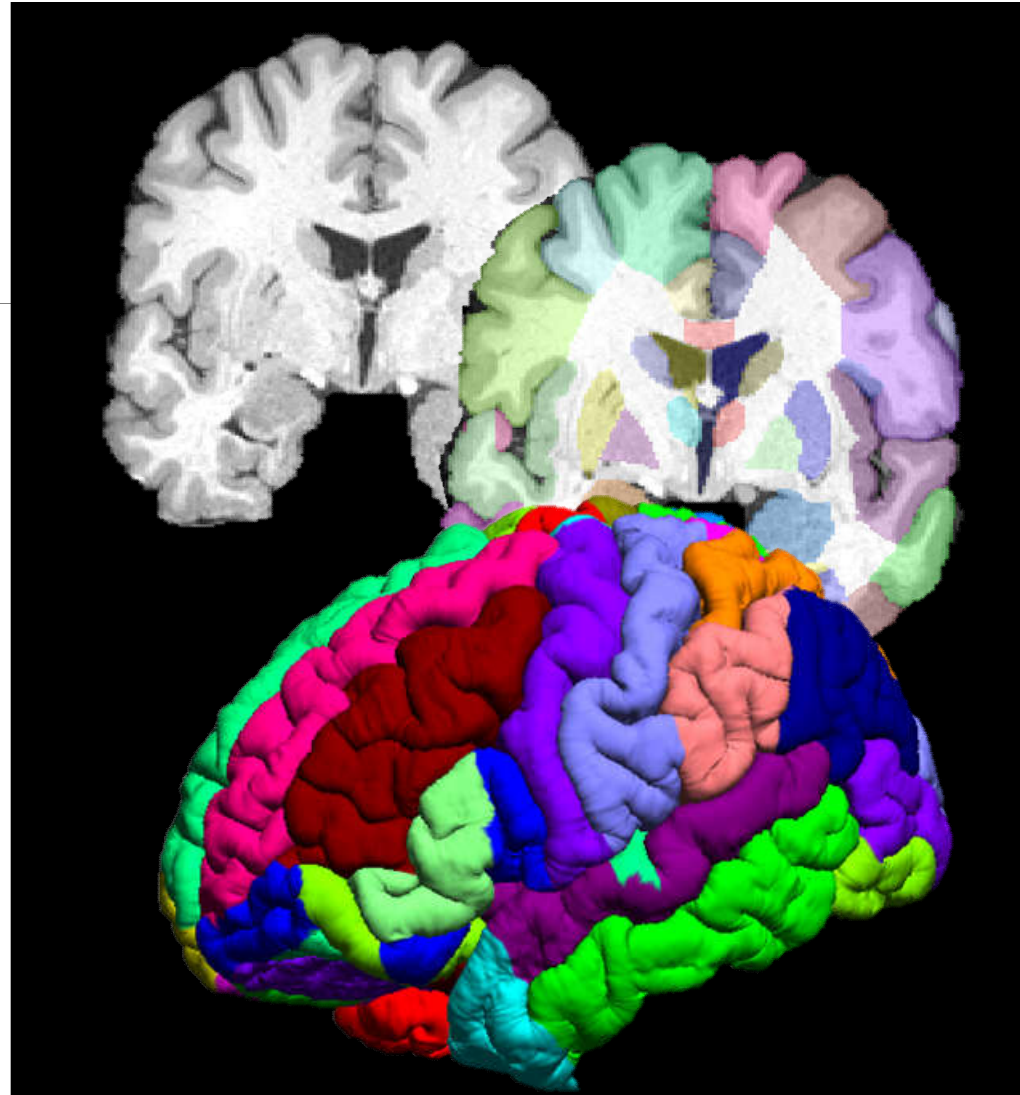
Ideal candidate for registration template

Segmentation by Hanna Damasio

- Specific considerations for SVReg application

More information

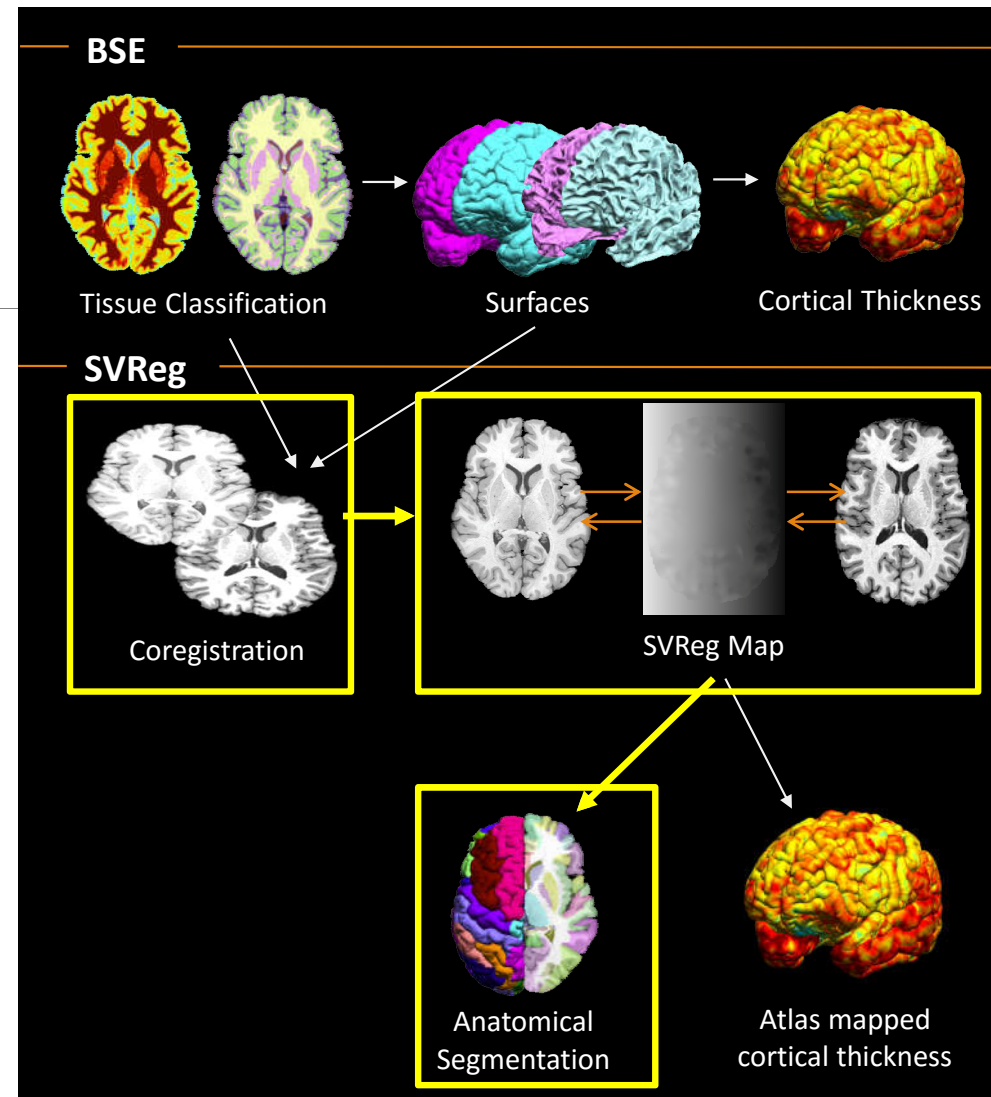
- http://brainsuite.org/svreg_atlas_description/



Segmentation

Atlas labels transferred to subject

- Surface labels (66 ROIs)
- Volumetric labels (95 ROIs)
 - ROI description: XML file
- Sulcal Delineation (52 Sulci)



Hands on: Checking outputs

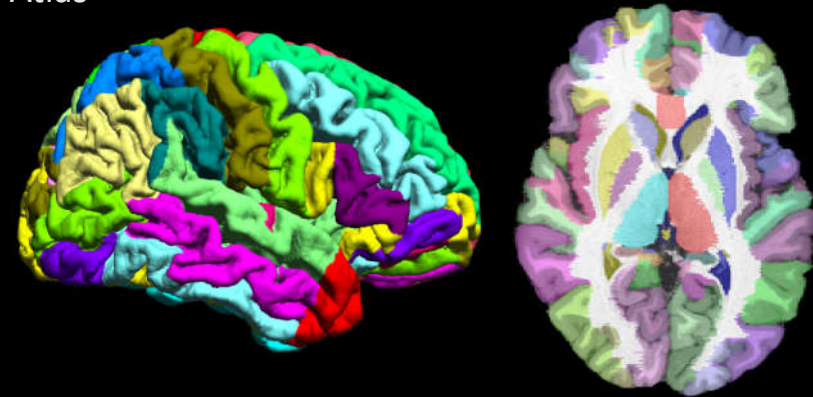
Subject and Atlas side-by-side comparison

- Surface labels
 - <subbasename>.mid.left.cortex.svreg.dfs
 - <subbasename>.mid.right.cortex.svreg.dfs
- Volumetric labels
 - <subbasename>.svreg.label.nii.gz
- ROI description: XML file

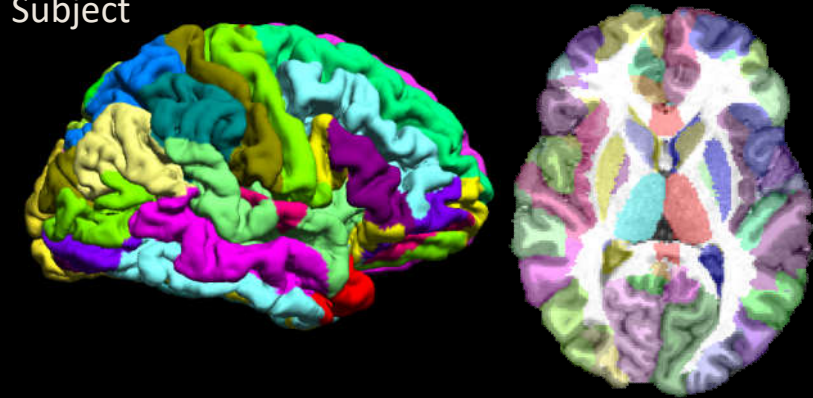
Installation Directory

Windows	C:\Program Files\BrainSuite15c\svreg\BCI-DNI_brain
Mac	/Applications/BrainSuite15c/svreg/BCI-DNI_brain

Atlas



Subject



Hands On: Customizing atlas

Volume labeling modification

- Labeling tool

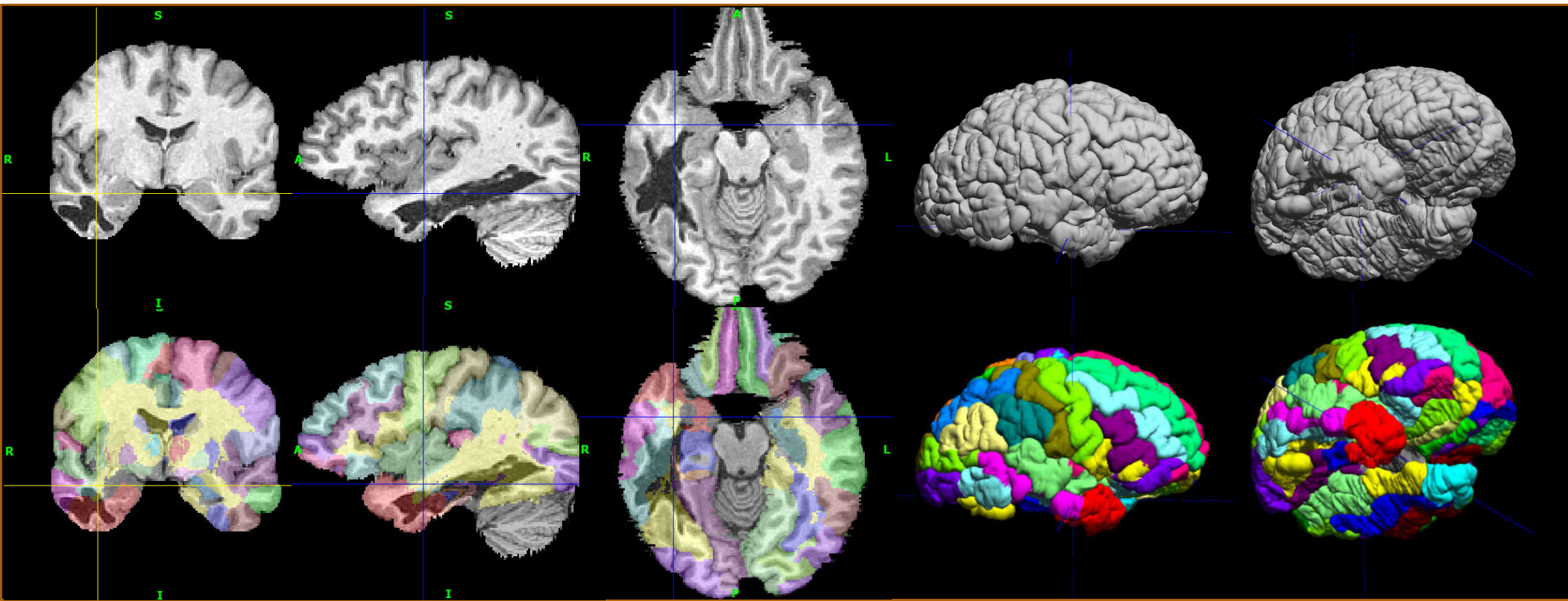
Surface viewer

- Recolor surface
- Labels to surface

Navigating Files

File extension	Description	Usage
.nii.gz	3D or 4D Volume	Images, labels, masks, maps
.dfs	Surfaces	Cortical surfaces, 3D surfaces of masks and labels
.xml	Description file	ROI and sulcal description

Lesion subjects



Choi S, Bhushan C, Joshi AA, Raphel K, Tranel D, Shattuck D, Halder J, Leahy RM, Damasio H, Wisniewski J (2013) Altered orbitofrontal tissue microstructure in patients with chronic anterior temporal lobe lesions, 19th Annual Meeting of the Organization for Human Brain Mapping, Seattle, WA, June 2013.

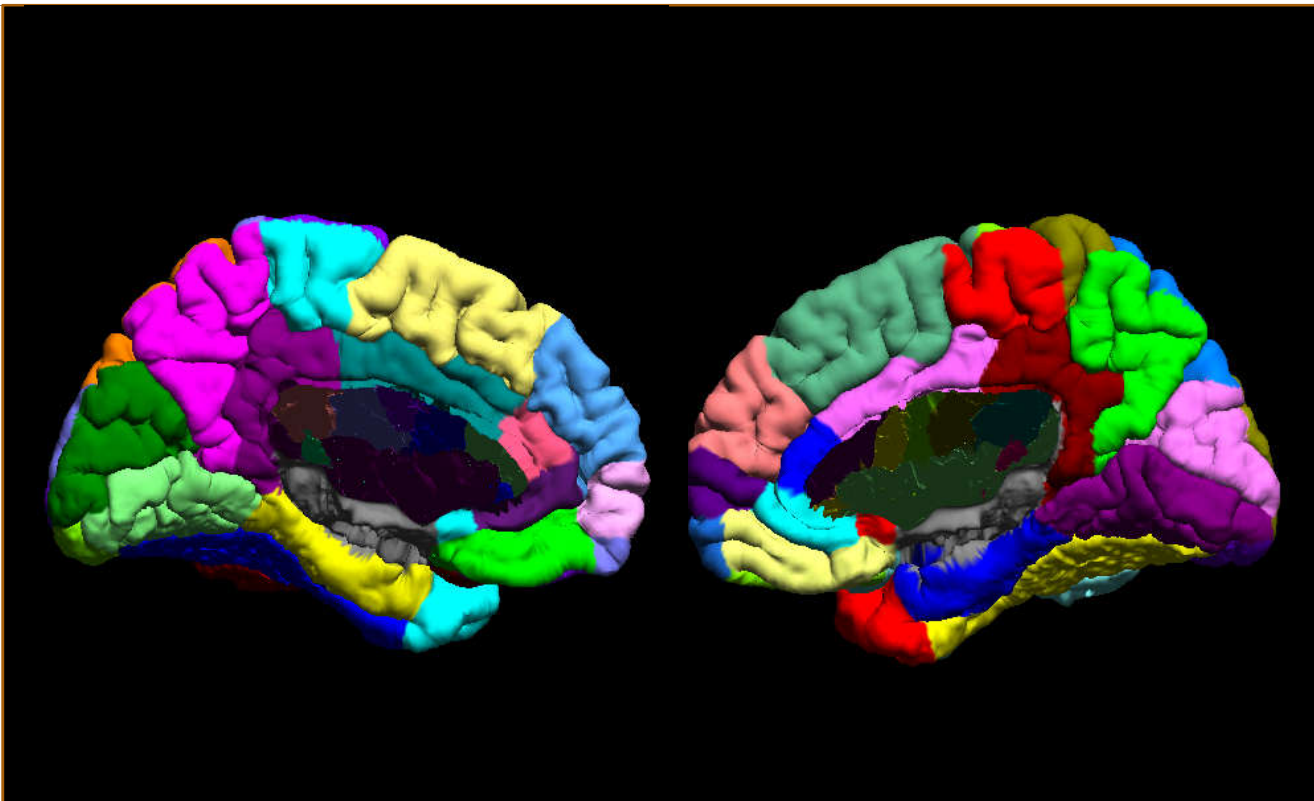
Customizing the Atlas

Customize ROIs

1. GUI—Label Tool
2. Command Line Tool
 - `make_atlas.exe (.sh)`

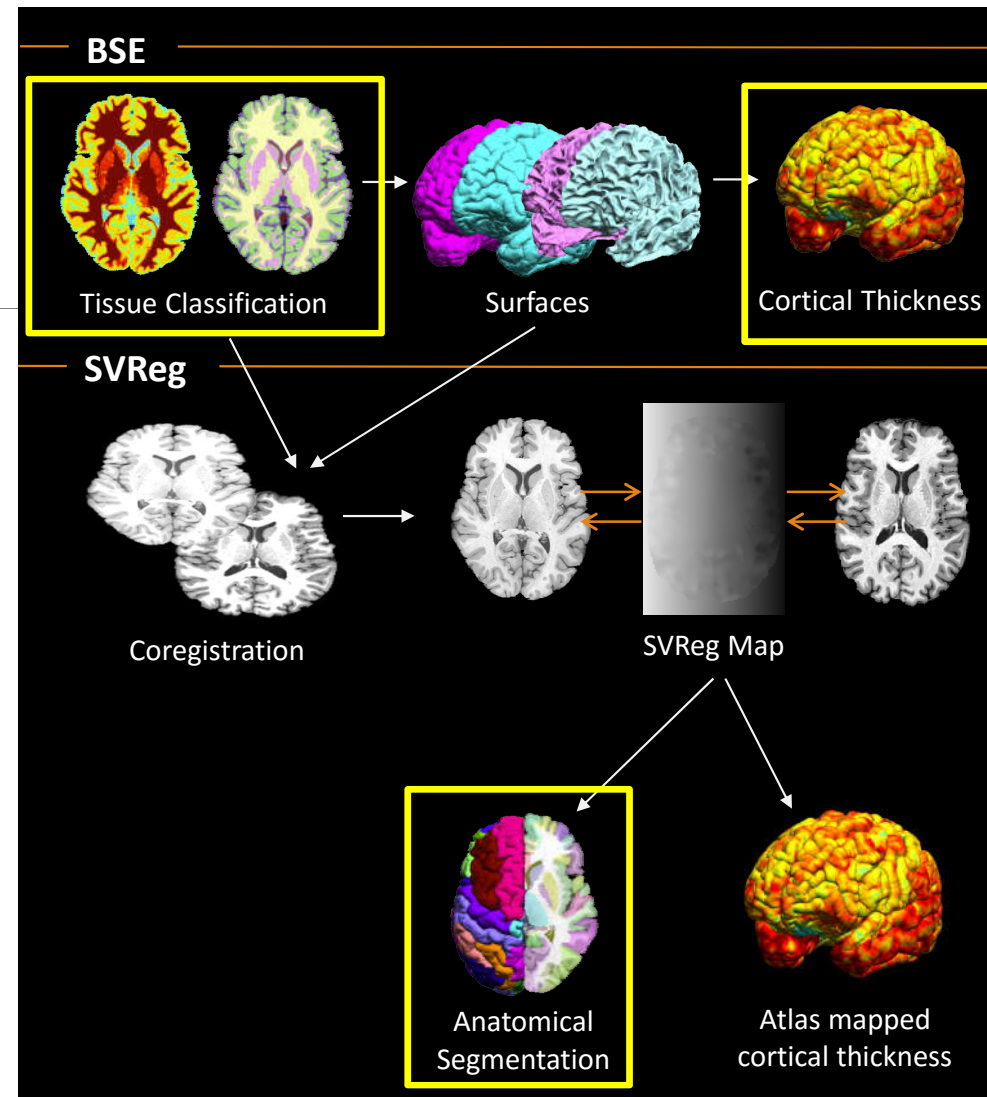
Create atlas from your own MRI

1. Run BSE & SVReg
2. Label modifications (optional)
3. Command Line Tool
 - `make_atlas.exe (.sh)`



ROI measurements

Statistical analysis



ROI-wise measurements

Default SVReg Output

- <subject>.roiwise.stats.txt

	A	B	C	D	E	F	G	H	I
1	ROI_ID	Mean_Thickness(mm)	GM_Volume(mm^3)	CSF_Volume(mm^3)	WM_Volume(mm^3)	Total_Volume(GM+WM)(mm^3)	Cortical_Area_mid(mm^2)	Cortical_Area_inner(mm^2)	Cortical_Area_pial(mm^2)
2	1	NaN	0	270316.8489	0	270316.8489	0	0	0
3	2	NaN	667372.5177	0	0	667372.5177	0	0	0
4	3	0	0	0	531689.3608	531689.3608	0	0	0
5	120	4.918154	31682.78444	15131.13535	16120.35223	47803.13668	8343.094172	6930.536957	11159.80197
6	121	5.16436	32363.38333	14358.27492	16728.6538	49092.03713	8316.684379	6650.780616	11331.93463
7	130	4.591067	14592.19002	6147.093362	7109.587516	21701.77754	4041.806453	3283.742585	5532.089574
8	131	4.777991	15131.20209	5957.293047	7603.595793	22734.79788	4212.752539	3411.067945	5839.75223
9	142	4.534774	4419.602245	1672.954477	2287.773548	6707.375793	1284.358831	1078.169796	1709.30567
10	143	4.494224	4868.535692	1650.184845	2835.169765	7703.705457	1390.658244	1225.80525	1811.617632
11	144	4.581163	7673.670788	3214.258909	4291.360792	11965.03158	2177.139586	1840.835155	2964.113315
12	145	4.695104	6678.669636	2643.994572	3513.166207	10191.83584	1889.279292	1652.156266	2508.305347
13	146	5.170467	2015.981915	765.033718	867.174484	2883.1564	535.514175	503.640707	724.055625
14	147	4.731952	2354.485513	835.938827	747.705786	3102.1913	646.197876	514.085359	902.38835
15	150	4.026758	14274.58312	5847.710355	9233.46747	23508.05059	4408.908408	3872.749863	5445.933947
16	151	3.966801	13368.17535	5272.816136	8391.259383	21759.43474	4098.133167	3751.016642	4892.821382
17	162	5.702871	2131.620544	1337.655651	863.863945	2995.484489	510.482812	381.245286	739.731435
18	163	6.069964	2624.802933	1309.496214	976.061011	3600.863944	635.267329	438.014683	1055.021471
19	164	5.044795	4949.28042	1539.862068	1525.43777	6474.71819	1338.416789	1030.271862	1859.756048
20	165	4.674791	4629.968091	797.270559	1746.781581	6376.749672	1327.686601	1122.635927	1676.56827
21	166	4.826359	3127.00921	1087.775388	1455.005584	4582.014795	894.730221	771.813689	1193.490361
22	167	3.549797	2298.155507	737.916551	1354.258083	3652.413591	842.348363	724.325055	1056.880142
23	168	5.44054	2691.022747	955.085679	1099.331777	3790.354574	674.640938	620.34147	871.867674

ROI-wise measurements

Volumetric—PVC

- GM Volume (mm^3)
- WM Volume (mm^3)
- Total Volume (mm^3)
- CSF Volume (mm^3)



ROI-wise measurements

Volumetric—PVC

- GM Volume (mm^3)
- WM Volume (mm^3)
- Total Volume (mm^3)
- CSF Volume (mm^3)

Surface based—cortical ROIs only

- Mean Thickness (mm)
 - Average cortical thickness in region
 - PVC method available*
- Cortical Area (mm^2)
 - Inner cortex
 - Mid cortex
 - **Pial cortex**



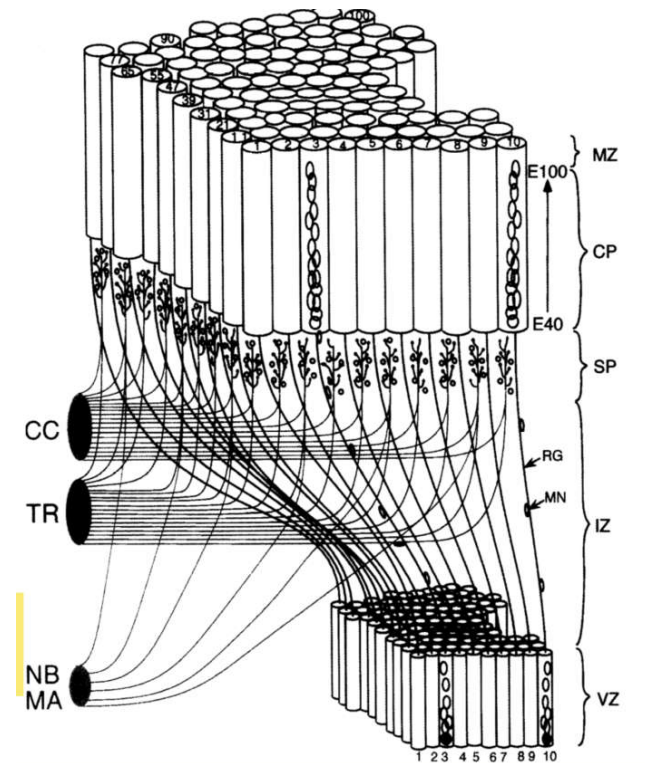
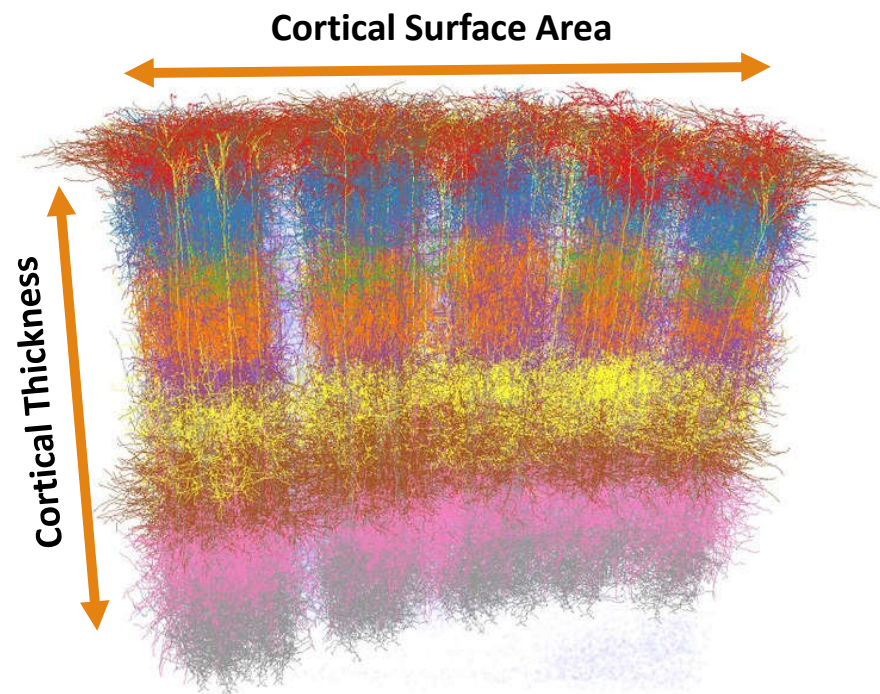
Cortical ROIs

Surface registration → cortical labels

- Excludes hippocampus and amygdala

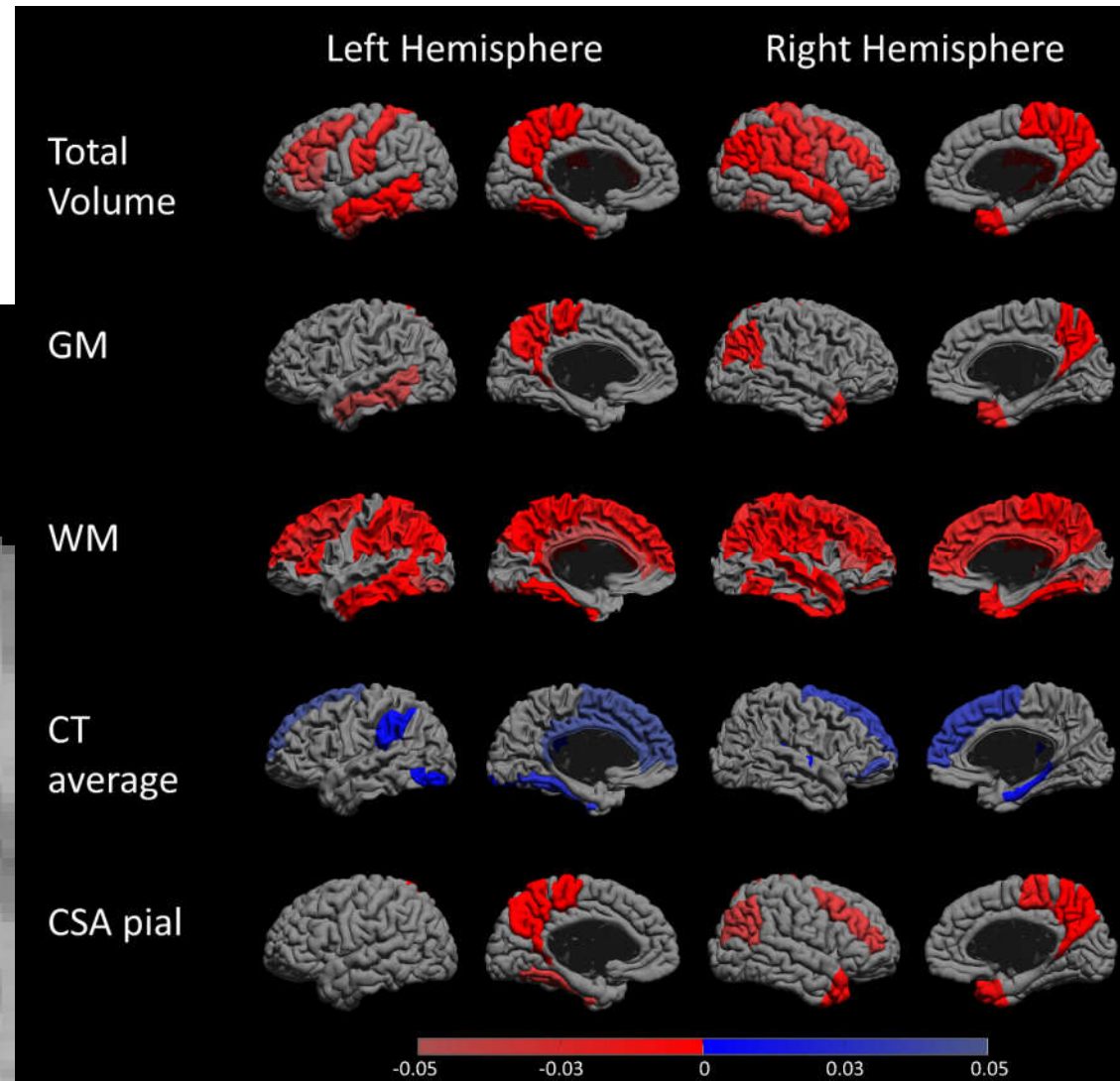
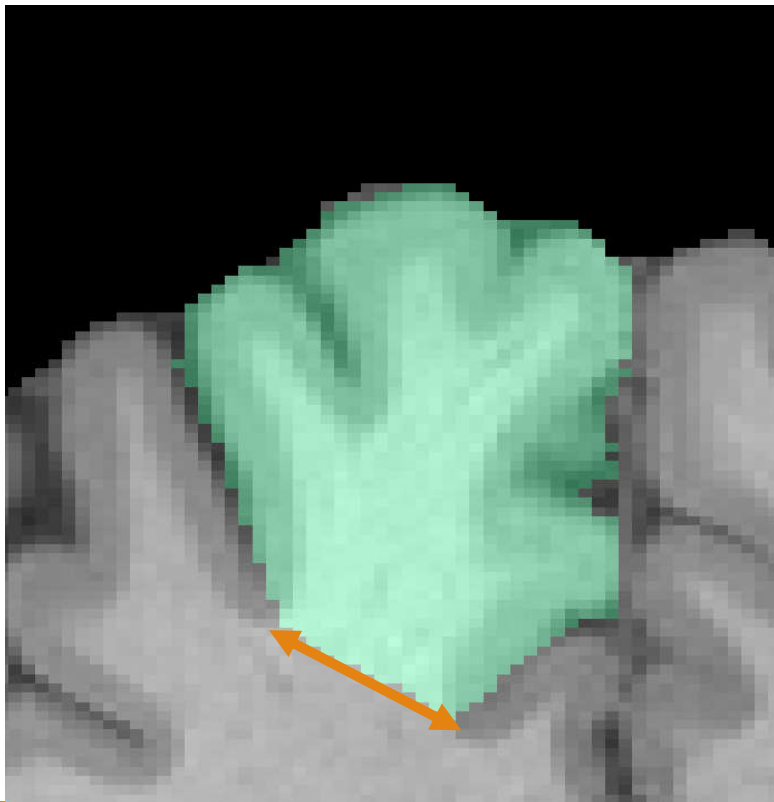


GM Attributes:



Rakic, P. A small step for the cell, a giant leap for mankind: A hypothesis of neocortical expansion during evolution. *Trends Neurosci.* **18**, 383–388 (1995).

Gyral WM



Cortical thickness

Filenames:

- atlas.right.mid.cortex.svreg.dfs
- atlas.left.mid.cortex.svreg.dfs

Description:

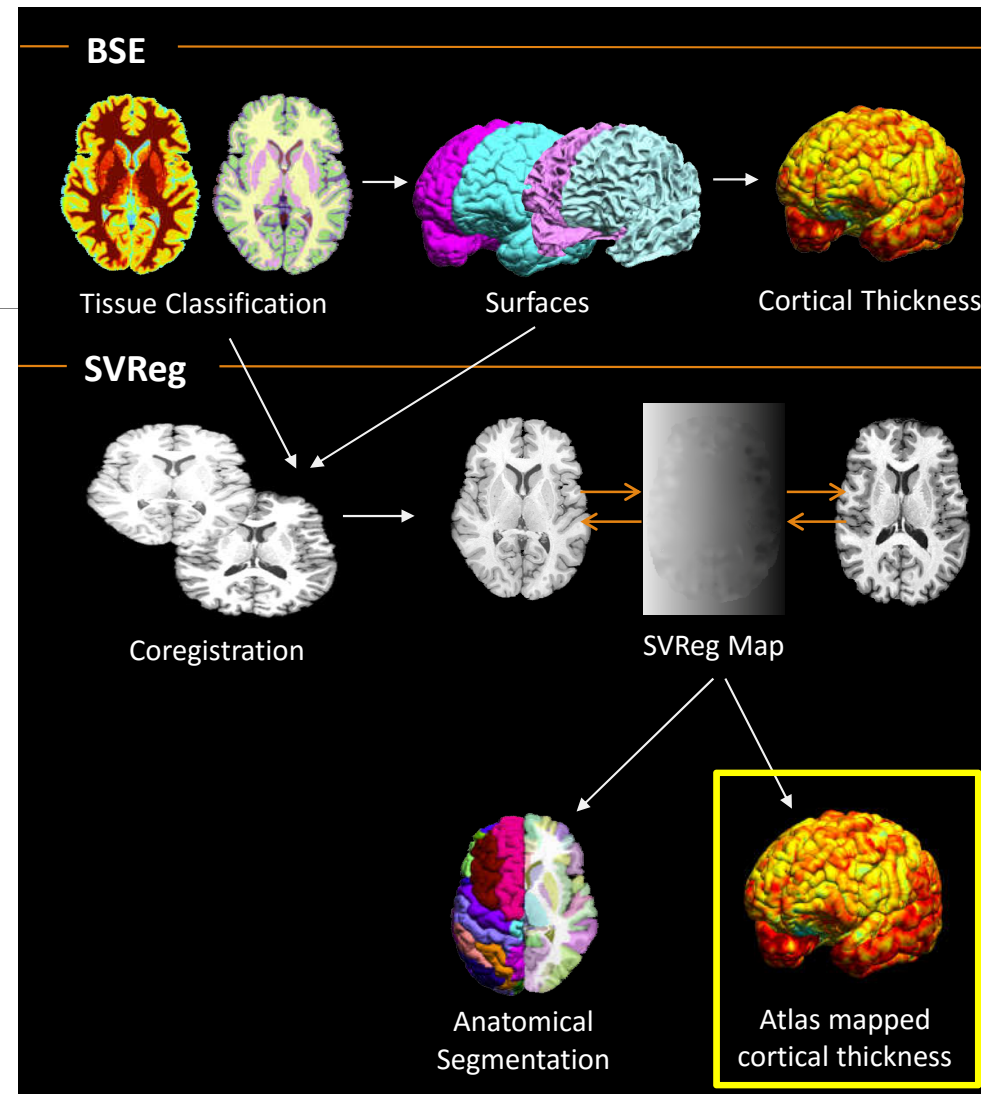
- Subject cortical thickness mapped to atlas surfaces

Usage:

- Vertex-wise statistical analysis (BSS toolbox)

Additional usage

- Contains transformation information
subject → atlas



SVReg Map

Filenames:

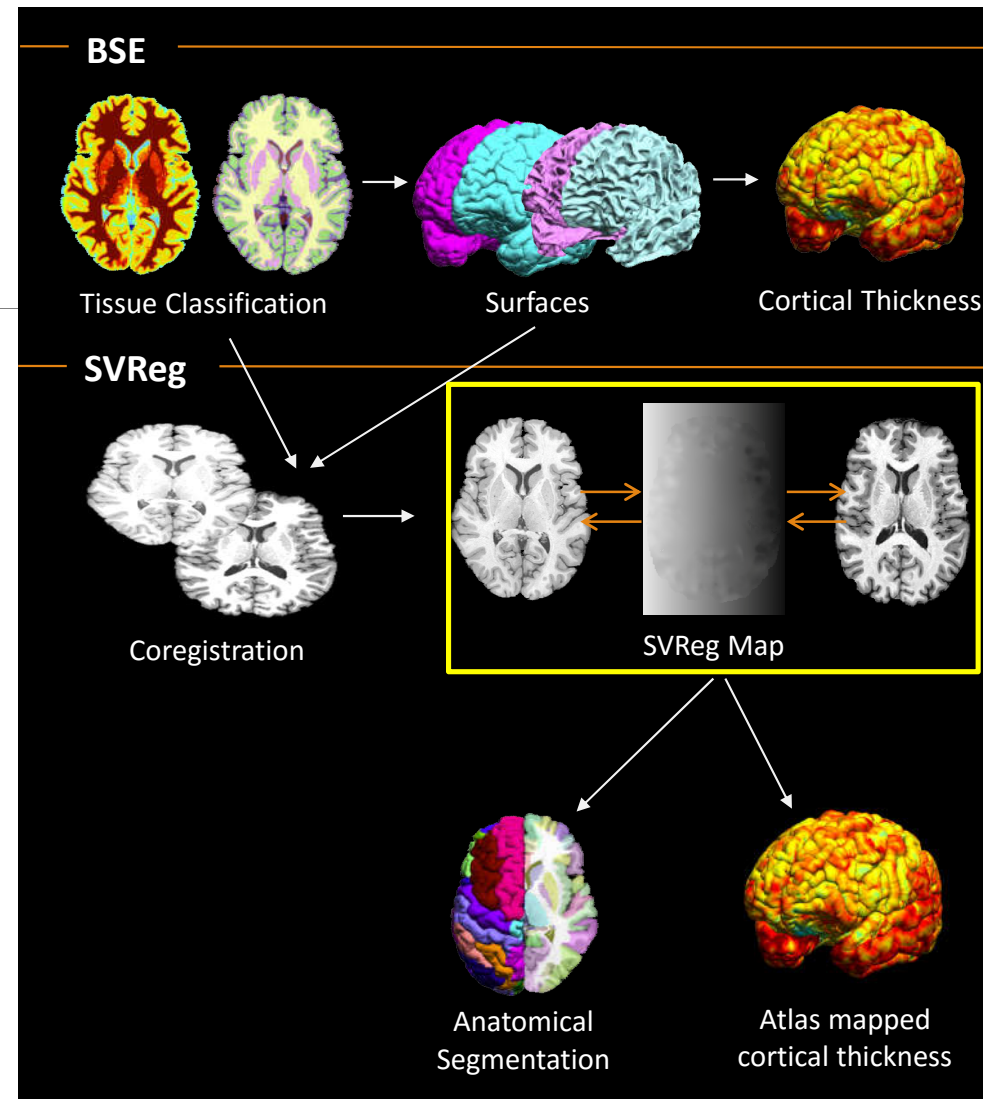
- <subbasename>.svreg.map.nii.gz
 - Subject → Atlas
- <subbasename>_inv.svreg.map.nii.gz
 - Atlas → Subject

Description

- Deformation map to transform volumes between atlas and subject T1-coordinates

Usage

- Command line tool
- Transform any volume in subject T1 or atlas space
- Can then be mapped to atlas surface



Online Resources

- **SVREG DOCUMENTATION**
BRAINSUITE.ORG/PROCESSING/SVREG/
- **ADDITIONAL TOOLS**
BRAINSUITE.ORG/PROCESSING/ADDITIONAL-TOOLS/
[HTTP://NEUROIMAGE.USC.EDU/NEURO/RESOURCES/BST_SVREG_UTILITIES](http://NEUROIMAGE.USC.EDU/NEURO/RESOURCES/BST_SVREG_UTILITIES)
- **GUI INTERFACE**
BRAINSUITE.ORG/INTERFACE/
- **HAVE A QUESTION?**
SUBMIT IT TO OUR FORUMS!
FORUMS.BRAINSUITE.ORG/

