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1. Left column: The figure shows the results from the N-butyl alchohol experiment. The top panel shows the original 2D spectrum of the N-butyl alcohol data. The bottom panel shows the spectrum reconstructed from the estimates of the EM-algorithm parameters. The data are taken from [23]. Right column: The figures show the EM algorithm reconstruction of the COSM data taken from Dr. Keeling of Washington University; the data reconstructions are from [30]. The top row shows X–Z sections through the COSM amoeba data. The bottom row shows the 200th EM algorithm iteration for sections through the COSM amoeba data.
2. Panel 1 shows the EM algorithm fit of G,W,CSF and partial volume compartments to brain tissue histograms to illustrate the segmentation calibration. The top solid curve superimposes the measured histogram data almost exactly. The lower dashed lines depict each of the compartment fits taken separately. Panel 2 shows an MRI section of the cingulate; panel 3 shows the Bayes segmentation into G,W, CSF compartments of coronal sections of the cingulate gyrus; Panels 4 and 5 show the same as above (row 1) for the medial prefrontal gyrus. Data taken from the laboratories of Dr. John Csernansky and Dr. Kelly Botteron of Washington University
3. Top row: Panel 1 shows the triangulated graph for the template representing amoeba corresponding to spherical closed surfaces. Generators are $g_i = (v_1, v_2, v_3)$, elements of $\mathbb{R}^9$. Panel 2 shows the triangulated for the closed surface representing the bounding closed surface of the hippocampus in the human brain. Panel 3 shows the surface representation of a macaque brain from the laboratory of David Van Essen. Bottom row: Shows a generator shown in standard position, orientation under rotation and translation transformation.
4. Top row: Panel 1 shows the triangulated graph representing the hippocampus generated by isocontouring; panel 2 shows the mean curvature map superimposed on the hippocampus surface of the human. Data taken from Haller et al. [162]. Bottom row: Panels 3 and 4 shows the same as above for macaque cortical surface reconstructed from cryosection data from the laboratory of Dr. David Van Essen. Bright areas represent areas of high positive mean curvature; dark areas represent areas of high negative mean curvature.
5. Top row: Panel 1 shows the atlas depiction of the occipital cortex. Panel 2 shows the reconstruction of the occipital cortex depicting the major sulcal and gyral principal curves including the inferior Calcarine sulcus and Lingual and Parietal gyri. Data taken from Dr. Steven Yantis of the Johns Hopkins University.
6. Left column shows the medial prefrontal cortex section from the Duvernoy atlas. Middle column top and bottom panels show the isosurface reconstruction of the prefrontal medial cortex. Sections through the two different MRI brains show the embedded surfaces. Right column, top and bottom panels, shows the medial prefrontal cortex reconstructions. Data taken from Dr. Kelly Botteron of Washington University.
7. Top row: Panel 1 shows eight geodesics generated on the neocortex by picking the start and end points manually. Panel 2 depicts geographical landmarks on the macaque cortex; labels 1, 2, 3, 4, 5, 6. Panel 3 shows a table of Riemannian distances in millimeters between the predefined points. Data taken from the laboratory of David Van Essen, Washington University. Bottom row: Figure shows optimality of dynamic programming. Panel 4 shows the Visible Human cortex extracted by David Van Essen; panel 5 shows choosing multiple terminal points for the DP solution; panels 6, 7 show the DP generation of the superior temporal sulcus jumping across the break connecting the start and end points which were manually selected.
8. Top row panel 1 shows the external view of the Superior Temporal Gyrus (STG). Panel 2 shows Heschl's gyrus and the posterior boundary of the plenum temporale (PT) defined via dynamic programming. Panel 3 shows the delineation of the STG surface into two with the PT as the blue region which is extracted. Bottom row shows the application of dynamic programming to extract the PT from STG surface. Panel 4 tracks Heschl's gyrus; panel 5 tracks the STG as far as the posterior ascending (or descending) ramus; panel 6 tracks the geodesic from the end of the STG to the retro-insular end of the Heschl's gyrus. Data taken

from the laboratory of Drs. Godfrey Pearlson and Patrick Barta, reconstructions from Dr. Tilak Ratnanather.

9. Left column: Top two panels show automatically and hand generated PT surfaces from one MRI brain; bottom two panels show a second PT generated automatically and by hand contouring. Right column shows the surface of the left PT from the STG shown superimposed with the mean-curvature map drawn over the planar coordinates at the location defined by the bijection $\phi : S(\triangle) \to D$. The retro-insular end of the HG and the positive y-axis passes through the posterior STG where the ramus begins. Also superimposed is the Heschl's sulcus in blue generated by dynamic programming tracking on the original surface. Data taken from the laboratory of Drs. Godfrey Pearlson and Patrick Barta; reconstructions from Dr. Tilak Ratnanather.
10. Top row: Panel 1 shows the reconstruction of the cortical surface with the curvature map superimposed. Shown depicted are various sulcal principal curves generated via dynamic programming. Panel 2 shows the planar representation of the medial cortex. Bottom row: Panel 3 shows the reconstruction of the left and right MPFC from Dr. Kelly Botteron. Panels 4 and 5 show the planar maps of the MPFC reconstructions superimposed curvature profiles. Data taken from Dr. Kelly Botteron of Washington University.
11. Left: shows the spherical template (top panel) and its deformed version (bottom panel) resulting from translation group applied to 4096 generators on the template. Right: Panels show deformations via the first four surface harmonics of the surface of the sphere.
12. Results from level set evolution showing different iterations $0, 1, 3, 5, 7, 10$ for a single face.
13. Figures show deformations corresponding to the solution of the random equation, $LU = W$. Left figure: Top left panel (a) shows the original image with the area of dilatation depicted; the top right panel (b) shows a contracting field $d_1 < 0$ and $d_2 < 0$; the bottom left panel (c) shows an expanding field $d_1 > 0$ and $d_2 > 0$; the bottom right panel (d) shows a shearing field $d_1 < 0$ and $d_2 > 0$. Right figure shows analogous deformations to the ventricles.
14. Panels 1–7 show the spherical harmonics 2–8 on the unit sphere computed numerically from the Laplacian operator on the sphere. Panel 8 shows the eigenvalues of the shift invariant covariance associated with the Laplacian operator.
15. Rows 1 and 2 show surface harmonics 1–8 of the Laplace Beltrami operator on the planum temporale. Rows 3 and 4 are identical for the central sulcus. Central sulcus results are visualized via a bijection to the plane. Surface harmonics taken from Qiu and Bitouk.
16. Figure shows planum temporal. Shown are the curvature profiles expanded in the complete orthonormal basis of the Laplace Beltrami operator.
17. Top row: Panel 1 shows the grid test pattern matching $A \to B$, $C \to D$ with the corners fixed. Panel 2 shows the movement of the grid under the diffeomorphism g_1; panel 3 shows the determinant of the Jacobian $|Dg_1|$. Bottom row: Panel 4 shows the trajectories of the particles $g_t(x_i), i = 1, 2, t \in [0, 1]$ traced out by the landmark points A,C and the four corners of the image projected into the plane. Panel 5 shows the small deformation mapping applied to the grid; panel 6 shows the determinant of the Jacobian $|Dg_1|$. Black to white color scale means large negative to large positive Jacobian. The variances were $\sigma^2 = 0.01$; mappings from Joshi [282].
18. Figure shows results of large deformation diffeomorphic landmark matching. Row 1: Panels 1 and 2 show brains 87A and target 90C, panel 3 shows 87A matched to 90C transformed via landmarks. Row 2: Panels 5, 6, 7, show sections through 87A, 90C, and 87A matched to 90C, respectively. Panel 4 shows the difference image between 87A and 90C; panel 8 shows difference image after landmark transformation. Mapping results taken from Johis [282]; data taken from David Van Essen of Washington University.
19. Panel 1 shows the CAD airframe with the inertial coordinates with linear and angular velocities. Panel 2 shows MSE as measured by the HSB versus noise in the case of three different motion priors: (i) no prior (broken line), (ii) motion prior, and (iii) strong prior (.-.-).
20. Left Half: Publicly available SAR data from the MSTAR program showing vehicles (rows 1,3) and SAR datasets (row 2,4). Right Half: Shows estimated variance for each pixel for the 72 azimuth angles spaced from 5° to 360° of a T72. Variances were estimated from training data in the MSTAR database.

50. AD Progression. Panel 1 shows deformations from baseline to follow-up for the CDR 0.5 AD group. Inward surface deformations due to AD are visualized in colder colors, outwards in warmer colors, and areas which are not deformed in neutral yellow to green colors. Panel 2 shows deformations from baseline to follow-up for the CDR 0 control group. Inward surface deformations due to AD are visualized in colder colors, outward in warmer colors, and areas which are not deformed in neutral yellow to green colors. Panel 3 shows follow-up-versus-baseline "spread" of the between-group inward surface deformation patterns, shown as Wilcoxon's sign rank test map on the CDR 0 mean surface. Areas of significant ($p < 0.05$) inward deformation at baseline of CDR 0.5 group are shown in turquoise color, representing 38% of total hippocampal surface area. By follow-up, areas of significant inward deformation have increased to 47% of total hippocampal surface area. The increased affected areas are shown in purple color. Areas of non-significant surface deformation are shown in green color. Panel 4 shows statistical testing of shape differences: log-likelihood ratios for a linear combination of basis functions {1,2,4,11}. Multivariate ANOVA of the first 12 basis functions indicates significant between-group difference: $p = 0.014$ ($F = 2.66,\ df = 12, 31$).

51. Depression. Panel shows differences of hippocampal surface patterns between the control and depression groups visualized as perpendicular displacements on the mean surface of the control group. Inward surface deformations due to depression are visualized in colder colors, outward in warmer colors, and areas which are not deformed in neutral yellow to green colors. Multivariate ANOVA of the first 10 basis functions indicates significant between-group difference: $p < 0.0001$ ($F = 34.1,\ df = 10, 58$).

52. Empirical distribution $\hat{F}$ from randomized Fisher's test with 10,000 group permutations, between the group of control and schizophrenia subjects. Basis vectors {2,12,17} are selected. The $p = 0.0031$ value shown is calculated from Eqn. (17.25). Also shown are (i) $\hat{F}(T^2)$ value (solid blue line) of the control-versus-schizophrenia group comparison; (ii) theoretical F-distribution (solid red curve) with (3,26) degrees of freedom superimposed on the empirical distribution; and (iii) $p = 0.05$ (red dotted line) and $p = 0.01$ (red dot–dash line) for reference.

53. Figure showing heteromorphic deformations. The left panel shows an expansion or "push out"; the right panel shows a "push in".