Multiscale Symmetry Detection in Scalar Fields by Clustering Contours

Supplemental Figures

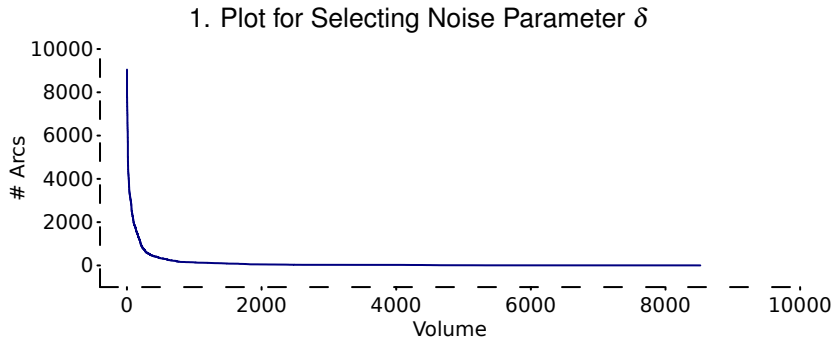

Fig. 1. The plot of the number of arcs in the contour tree with a specific value of volume as the value of the volume increases. The curve shows a significant drop initially due to the arcs corresponding to noise. A value immediately after this drop is chosen as the value of δ. The above plot corresponds to the Fuel dataset. Plots corresponding to the other datasets behave similarly.

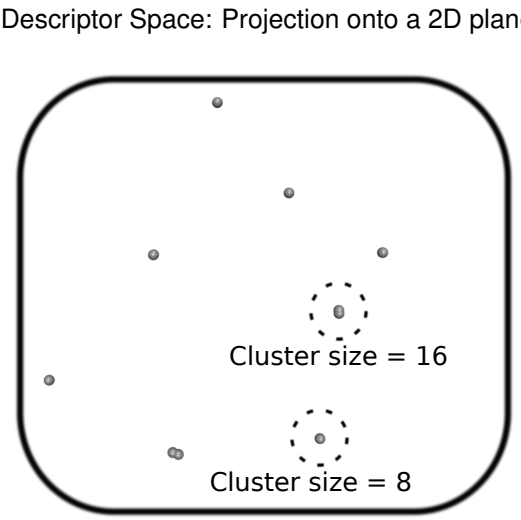

Fig. 2. Projection of 93 points in the descriptor space to 2D using multidimensional scaling for the dataset EMDB-1654. Observe that the clusters are well separated. For the two clusters within the dotted circles, their sizes are annotated below the cluster.

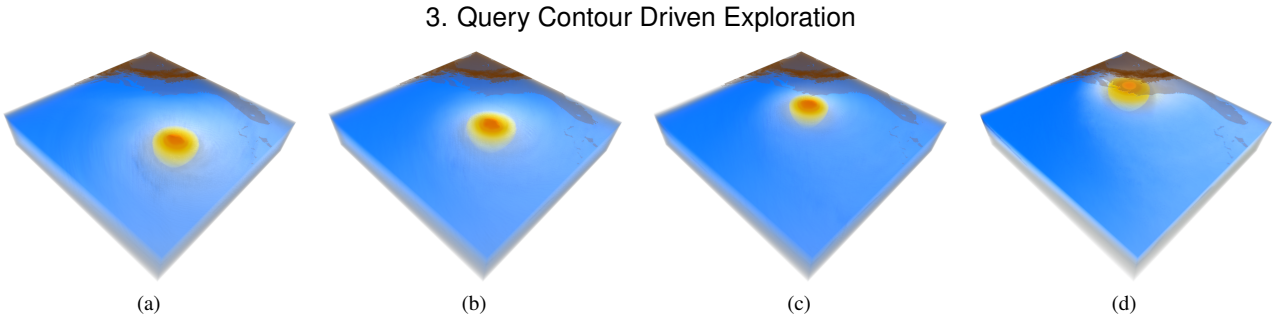

Fig. 3. Low pressure regions extracted through query contour driven exploration of the hurricane Isabel dataset. The yellow regions highlight the volumetric regions identified from the time steps, 12, 24, 36, and 48, using the query contour from the first time step shown in Figure 7(c). The extracted regions are displayed in the context of the rest of the volume.

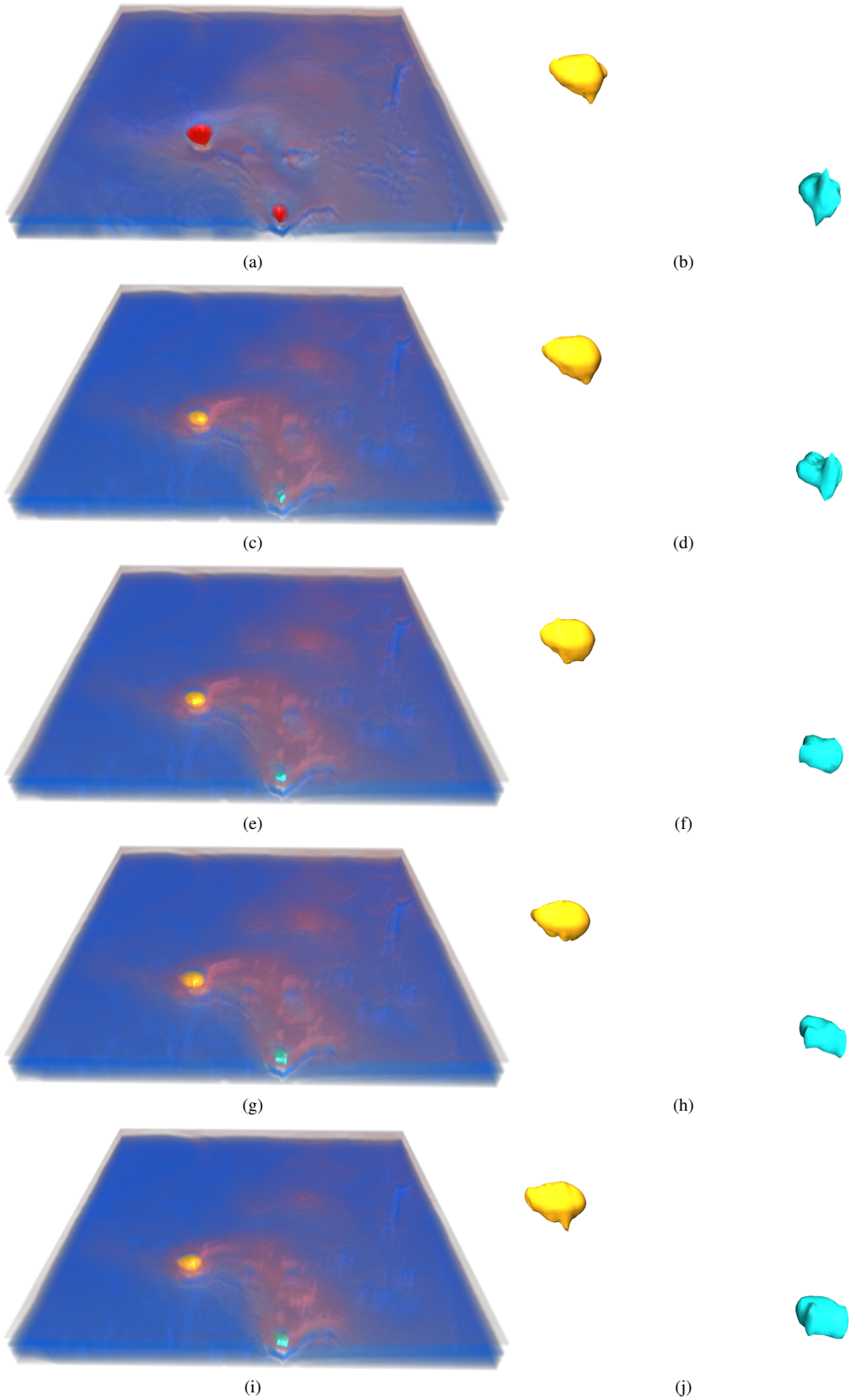

Fig. 4. Query contour driven exploration using multiple contours on a weather simulation dataset of size $306 \times 285 \times 27$. (a) Volume rendering of the pressure field from the first time step of the simulation shows two depressions in the Pacific ocean in red. (b) Two query contours selected from the low pressure region of the first time step shown in gold and cyan. (c)-(j) The result of the query on four subsequent time steps that are one hour apart shows the two low pressure regions detected in gold and cyan. The left and the right columns show the volumetric region extracted and the contour located, respectively.

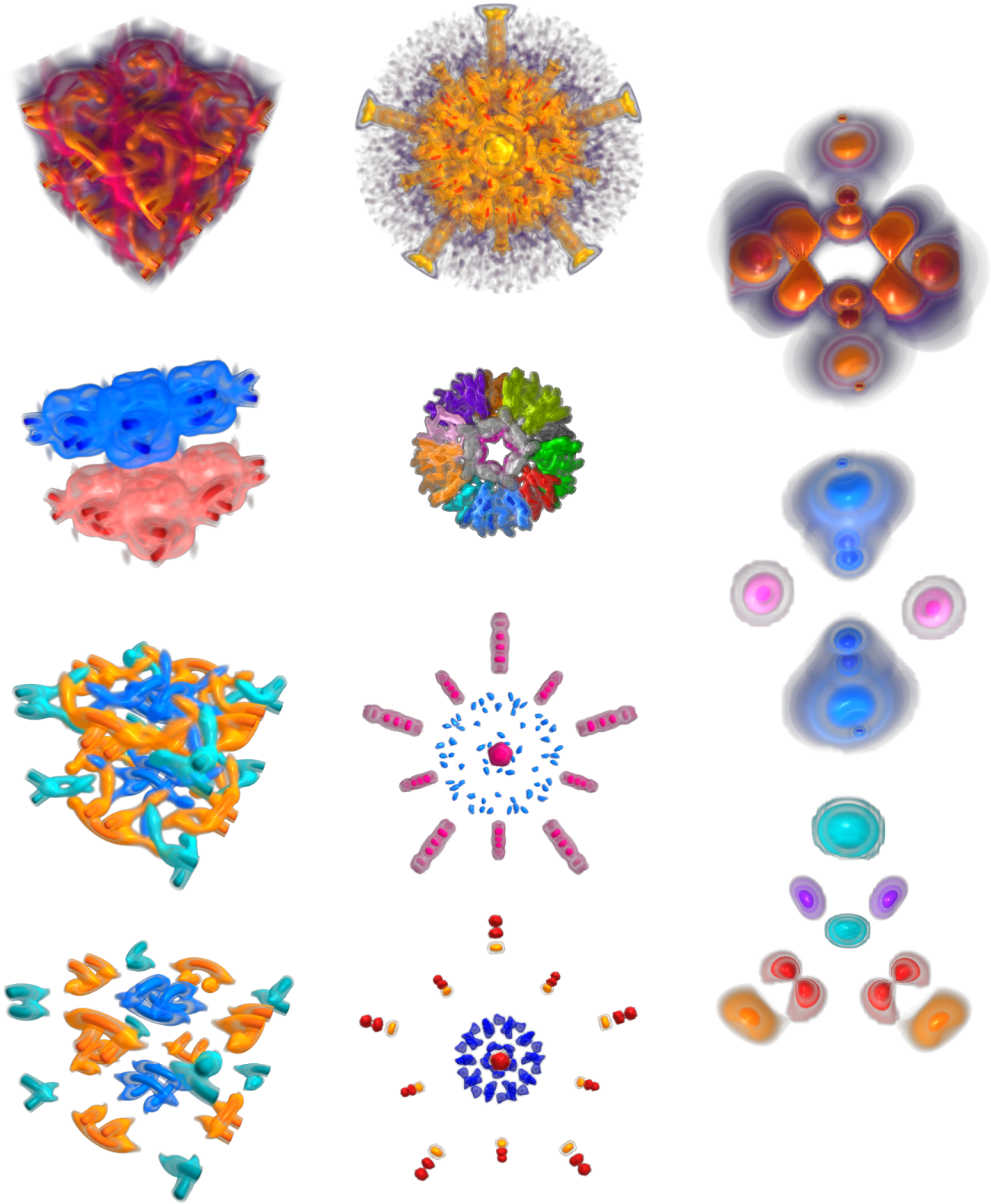

Fig. 5. Multiscale symmetry detected on (left column) Vortex (middle column) EMDB-1179 and (right column) Neghip datasets. The topmost figure in each column shows a volume rendering of the dataset and different symmetric regions detected are shown below it.

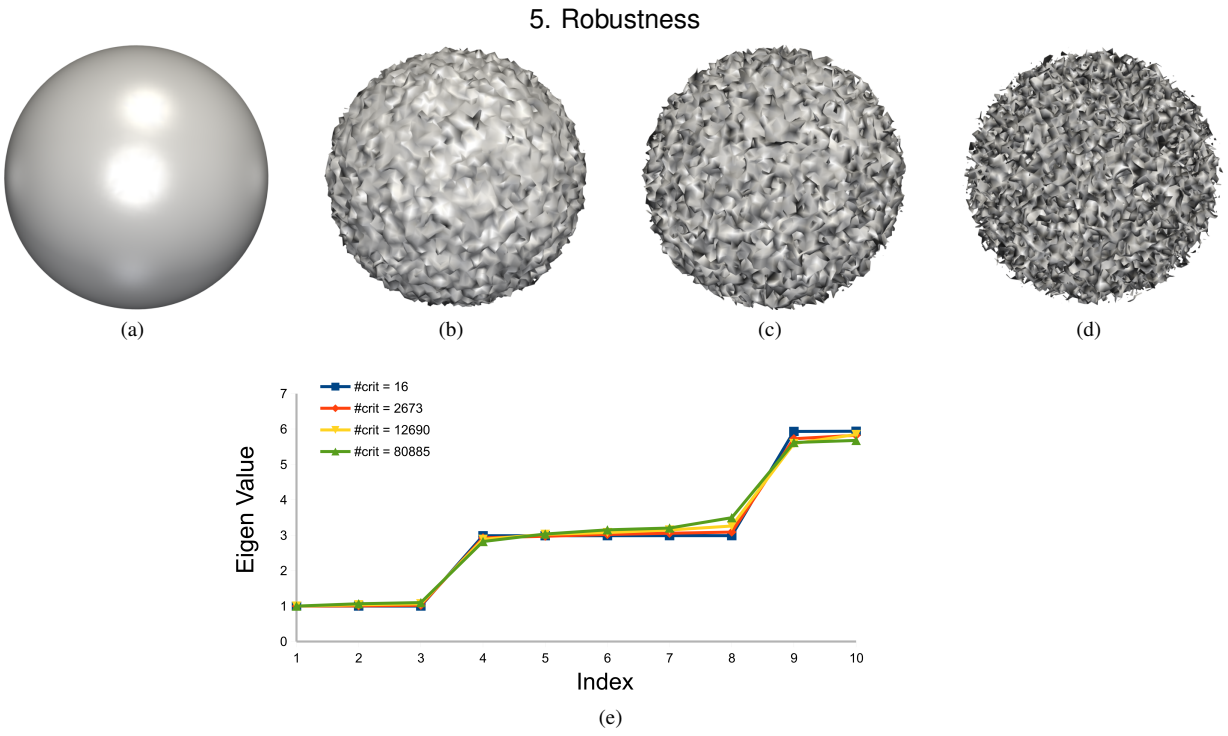

Fig. 6. Robustness to noise. (a) An isosurface of a synthetic dataset which has the shape of a sphere. The number of critical points for this dataset is 16. (b)-(d) Adding increasing levels of noise to the dataset deforms the isosurface. The number of critical points increase to 2673, 12690, and 80885. (e) For each datasets, the first ten non-zero eigen values of the Laplace-Beltrami spectra are normalized by dividing with the first non-zero eigen value and plotted as a 1D curve. The similarity of the curves shows that the similarity of the contours can be identified easily even in the presence of noise.

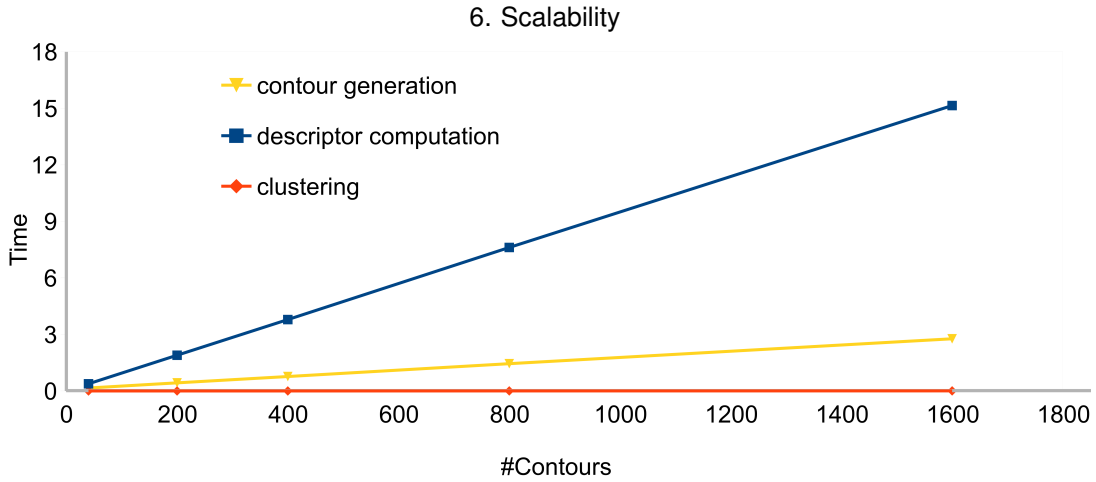

Fig. 7. Computational performance scales linearly with respect to the number of contours. The time taken, in seconds, for contour generation, descriptor computation, and clustering are plotted when the number of contours processed are 40, 200, 400, 800, and 1600. The plot shows linear scale up in the computation time for contour generation and descriptor computation. The nearest neighbor search takes only a fraction of a second. The contours are generated from the dataset EMDB-1654. To limit the variation in performance due to differences in the size of the contours, this experiment was performed with contours belonging to a single scale.