A Matlab Toolbox for Visualization of Image Manifolds

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***Abstract*—While manifolds have attracted significant attention from the image processing and computer vision communities, we are not aware of openly available tools for visualization of manifold-modeled data that allows for interactive navigation over the embedded dataset. We introduce the Manifold Analysis GUI (MAGI), a freely available toolbox for Matlab that provides a navigation interface for manifold-modeled image datasets. The inputs to MAGI are a matrix of image data and a corresponding matrix of their embedding coordinates; the toolbox also includes an implementation of Isomap to provide a default nonlinear embedding. MAGI displays a 2-D projection of the embedding that can be navigated interactively, showing the image corresponding to the embedding point closest to the mouse cursor.**

***Index Terms*—Image processing, manifolds, visualization, MATLAB**

Manifold models have attracted significant attention in image processing and computer vision. However, it is difficult to find freely available visualization tools that allow for the validation of the manifold embedding obtained. For many parameterizable image classes, one often looks for interpretability in the value of the coordinates of the embedding. Examples include images of translated and rotated objects, such as the Faces dataset used to test Isomap [1]. In other cases, one aims to link certain features of the image to the location of the datapoint in the embedded space, such as the shape of the digits in the MNIST dataset used to test Isomap.

This paper introduces the Manifold Analysis GUI (MAGI), a Matlab GUI that provides the user with the ability to view the dataset images and the embedded manifold data at the same time. MAGI takes the image dataset as its first input, formatted either as a matrix where each column is a vectorization of an image in the dataset, or as a 3-D array where each 2-D section is an image from the dataset. In the former case, MAGI also requires the pixel dimensions of the images as additional inputs; it offers possible factorizations of the vectorized image length if the dimensions are not known a priori. MAGI uses the Isomap manifold learning algorithm [1] to obtain a nonlinear embedding of the dataset, where the dimensionality of the embedding is provided by the user as an additional input. Alternatively, the user can input an embedding of their choosing for MAGI, as a matrix where each column corresponds to the embedding of a datapoint, to be used during visualization.

Once the user has provided the required inputs, the GUI will open and display a window with two figures, cf. Fig. 1. The left figure is a 2-D graph displaying two of the dimensions of the embedded dataset, chosen by the user from drop-down boxes. The right figure that displays the image data. The user can activate the manifold navigation function of the GUI by left clicking anywhere in the left figure. As the user moves the mouse cursor over points in the graph, the point closest to the cursor will be highlighted and its associated image will be displayed on the rightmost window. To disable the manifold navigation function, one simply left clicks again in the graph window.

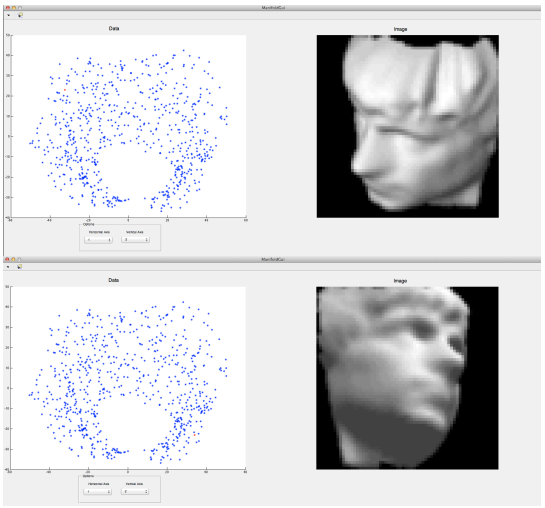

Fig. 1. Two Examples of the MAGI window with point interactivity enabled.

The MAGI toolbox is available online [2] bundled with several example manifold-modeled image datasets available on the web [1, 3, 4].

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