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*Joachim Giesen, Balint Miklos, Mark Pauly and Camille Wormser*

### The Scale Axis Transform

We introduce the scale axis transform, a new skeletal shape representation for bounded open sets  $O \subset \mathbb{R}^d$ . The scale axis transform induces a family of skeletons that captures the important features of a shape in a scale-adaptive way and yields a hierarchy of successively simplified skeletons. Its definition is based on the medial axis transform and the simplification of the shape under multiplicative scaling: the  $s$ -scaled shape  $O_s$  is the union of the medial balls of  $O$  with radii scaled by a factor of  $s$ . The  $s$ -scale axis transform of  $O$  is the medial axis transform of  $O_s$ , with radii scaled back by a factor of  $1/s$ . We prove topological properties of the scale axis transform and we describe the evolution  $s \rightarrow O_s$  by defining the multiplicative distance function to the shape and studying properties of the corresponding steepest ascent flow. All our theoretical results hold for any dimension. In addition, using a discrete approximation, we present several examples of two-dimensional scale axis transforms that illustrate the practical relevance of our new framework.