TVCG Papers in SGP 2019

Wrinkles, Folds, Creases, Buckles: Small-Scale Surface Deformations as Periodic Functions on 3D Meshes

Evgeny Zuenko, Matthias Harders

Abstract:
We propose a method for adding small-scale details to surfaces of 3D geometries in the context of interactive deformation computation of elastic objects. This is relevant in real-time applications, for instance, in surgical simulation or interactive animation. The key idea is the procedural generation of surface details via a weighted sum of periodic functions, applied as an on-surface displacement field. We first calculate local deformation strains of a low-resolution 3D input mesh, which are then employed to estimate amplitudes, orientations, and positions of high-resolution details. The shapes and spatial frequencies of the periodic details are obtained from mechanical parameters, assuming the physical model of a film-substrate aggregate. Finally, our approach creates the highly-detailed output mesh fully on the GPU. The performance is independent of the spatial frequency of the inserted details as well as, within certain limits, of the resolution of the output mesh. We can reproduce numerous commonly observed, characteristic surface deformation patterns, such as wrinkles or buckles, allowing for the representation of a wide variety of simulated materials and interaction processes. We highlight the performance of our method with several examples.

DOI: 10.1109/TVCG.2019.2914676

==

Joint Graph Layouts for Visualizing Collections of Segmented Meshes

Jing Ren, Jens Schneider, Maks Ovsjanikov, Peter Wonka

Abstract:
We present a novel and efficient approach for computing joint graph layouts and then use it to visualize collections of segmented meshes. Our joint graph layout algorithm takes as input the adjacency matrices for a set of graphs along with partial, possibly soft, correspondences between nodes of different graphs. We then use a two stage procedure, where in the first step, we extend spectral graph drawing to include a consistency term so that a collection of graphs can be handled jointly. Our second step extends metric multi-dimensional scaling with stress majorization to the joint layout setting, while using the output of the spectral approach as initialization. Further, we discuss a user interface for exploring a collection of graphs. Finally, we show multiple example visualizations of graphs stemming from collections of segmented meshes and we present qualitative and quantitative comparisons with previous work.

DOI: 10.1109/TVCG.2017.2751473

==

Hamiltonian Operator for Spectral Shape Analysis

Yoni Choukroun, Alon Shtern, Alex Bronstein, Ron Kimmel

Abstract:

Many shape analysis methods treat the geometry of an object as a metric space that can be captured by the Laplace-Beltrami operator. In this paper, we propose to adapt the classical Hamiltonian operator from quantum mechanics to the field of shape analysis. To this end we study the addition of a potential function to the Laplacian as a generator for dual spaces in which shape processing is performed. We present general optimization approaches for solving variational problems involving the basis defined by the Hamiltonian using perturbation theory for its eigenvectors. The suggested operator is shown to produce better functional spaces to operate with, as demonstrated on different shape analysis tasks.

DOI: 10.1109/TVCG.2018.2867513