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课题周汇报

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课题周汇报

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专业：数学与信息技术

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Cech cohomology and De Rham cohomology

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Differential Forms in
Algebraic Topology

With 92 Illustrations

CHAPTER II
The Čech–de Rham Complex

We've mainly discussed the chapter two of Differential Forms in Algebraic Topology.

Paper

There are two papers given by Professor Gu.

1.Reassembling Fractured Objects by Geometric Matching

2.Reconstruction of Deforming Geometry from Time-Varying Point Clouds

Reassembling Fractured Objects by Geometric Matching

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Helmut Pottmann, TU Wien

Abstract

We present a system for automatic reassembly of broken 3D solids. Given as input 3D digital models of the broken fragments, we analyze the geometry of the fracture surfaces to find a globally consistent reconstruction of the original object. Our reconstruction pipeline consists of a graph-cuts based segmentation algorithm for identifying potential fracture surfaces, feature-based robust global registration for pairwise matching of fragments, and simultaneous constrained local registration of multiple fragments. We develop several new techniques in the area of geometry processing, including the novel integral invariants for computing multi-scale surface characteristics, registration based on forward search techniques and surface consistency, and a non-penetrating iterated closest point algorithm. We illustrate the performance of our algorithms on a number of real-world examples.

CR Categories: I.3.5 [Computer Graphics]: Computational Geometry and Object Modeling—Geometric algorithms, languages, and systems; Curve, surface, solid, and object representations.

Keywords: geometric matching, integral invariants, feature-based registration, non-penetrating alignment, 3D puzzle.

1 Introduction

In the last few years, the problem of reassembling fractured 3D objects in a fully automatic way has gained an increasing importance,

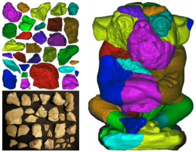

Figure 1: Reassembling a gargoyle statue: photo (bottom left) and 3D models (top left) of the fragments, final assembly (right).

is an arbitrary number of fracture surfaces per fragment, which can match over any part of their extent. Therefore, we need to identify fracture surfaces on the fragments, and find pairs of matching surfaces. In order to reassemble the entire 3D object, we need to decide which pairwise matches are correct, and find a global position for each fragment relative to other fragments. This is different from

Reconstruction of Deforming Geometry from Time-Varying Point Clouds

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Abstract

In this paper, we describe a system for the reconstruction of deforming geometry from a time sequence of unstructured, noisy point clouds, as produced by recent real-time range scanning

Relation between De Rham and Cech cohomology

Theorem

If $\mathfrak{U}$ is a good cover of the manifold M, then the de Rham cohomology of M is isomorphic to the Cech cohomology of the good cover

$$H^*_{DR}(M) \simeq H^*(\mathfrak{U}, \mathbb{R})$$

The relation between cohomology and homology

Theorem

(Poincare Duality). Let M be a manifold of dimension n and U any good cover of M satisfying the local finite condition (*). Here M is not assumed to be orientable. Then

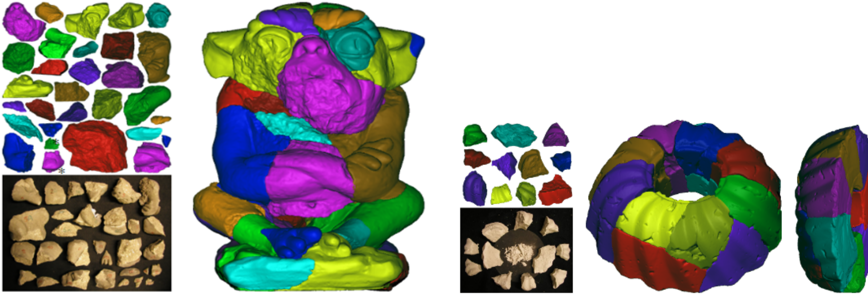
$$H_c^*(M) \simeq H_{n-*}(\mathbf{U}, \mathscr{H}_c^n)$$

where $\mathscr{H}_c^n$ is the covariant functor $\mathscr{H}_{\mathrm{c}}^n(U) = H_{\mathrm{c}}^n(U)$.
(*) each open set U_α intersects only finitely many U_β's.

more precisely,

$$H_c^*(M; R) \simeq H_{n-*}(M; R)$$

Paper1:Reassembling Fractured Objects by Geometric Matching



The problem of automatic 3D reconstruction :

Given:

3D digital models of the solid fragments obtained by 3D laser scanning of the fragment boundary surfaces

Goal:

automatically reassembling fractured 3D objects from digital models of their fragments.

Algorithm Overview:

The input: a set of **point cloud** surfaces representing the pieces of the fractured object.

Then:

1.automatically segments **the fragments into a set of faces** bounded by sharp curves.

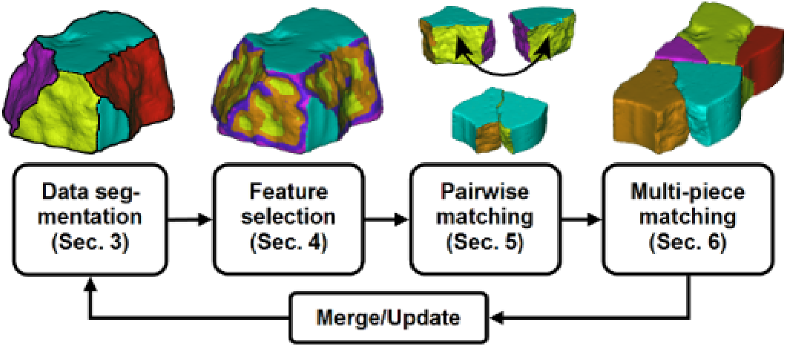
(By examining the roughness of the face surfaces,it can additionally classify the faces into original faces and fracture faces.

By examining the Sharpness of the face surfaces,It can identify the boundary curves)

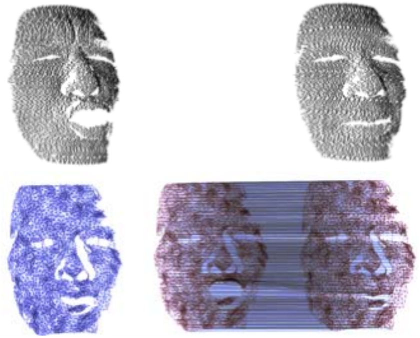
2. compute a novel type of patch-based **surface features** called feature clusters for all fracture faces

Feature clusters are based on **feature descriptors** which are some surface and curves **integral invariants**

3. use these features to match all fracture faces **pairwise**.
4. **The multi-piece matching**



Paper2:Reconstruction of Deforming Geometry from Time-Varying Point Clouds

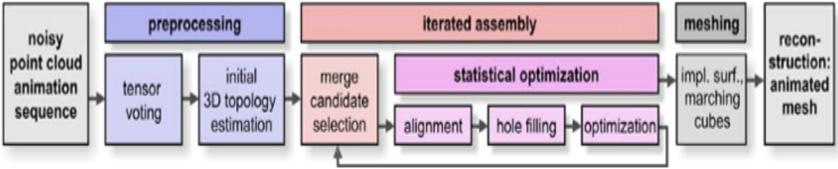


Problem of animation scanning

1.Due to the real-time capturing requirements, dynamic acquisition techniques suffer especially badly from **noise problems**.

2.The scanning device only outputs a series of 3D measurements without keeping **track of the movement of the physical object**.

Algorithm Overview



1.A **preprocessing step** extracts 3D pieces of geometry in each frame.

2.Adjacent frames are then iteratively merged **using a statistical model** to align pieces and optimize their shape as well as fill-in holes. (Bayer model, based on deforming geometry)

3.**an animated triangle mesh** is created by a marching cubes based surface extraction algorithm

Reflection

1.Cohomology and homology:

For surface M with genus g, we can compute its H^1 and H_1.Additionally, we can compute homology by using persistent homology(but it's not Homotopy equivalence)

2.What do we want to do?

Acquiring local point data,one can locally merges them step by step. So we need additional condition:global restriction

is it necessary?

3.In paper2, can we using persistent homology.

Thank you for your criticism and corrections

谢谢各位，多多批评指正*!*