3D Scan Matching and Registration

ICCV 2005 Short Course

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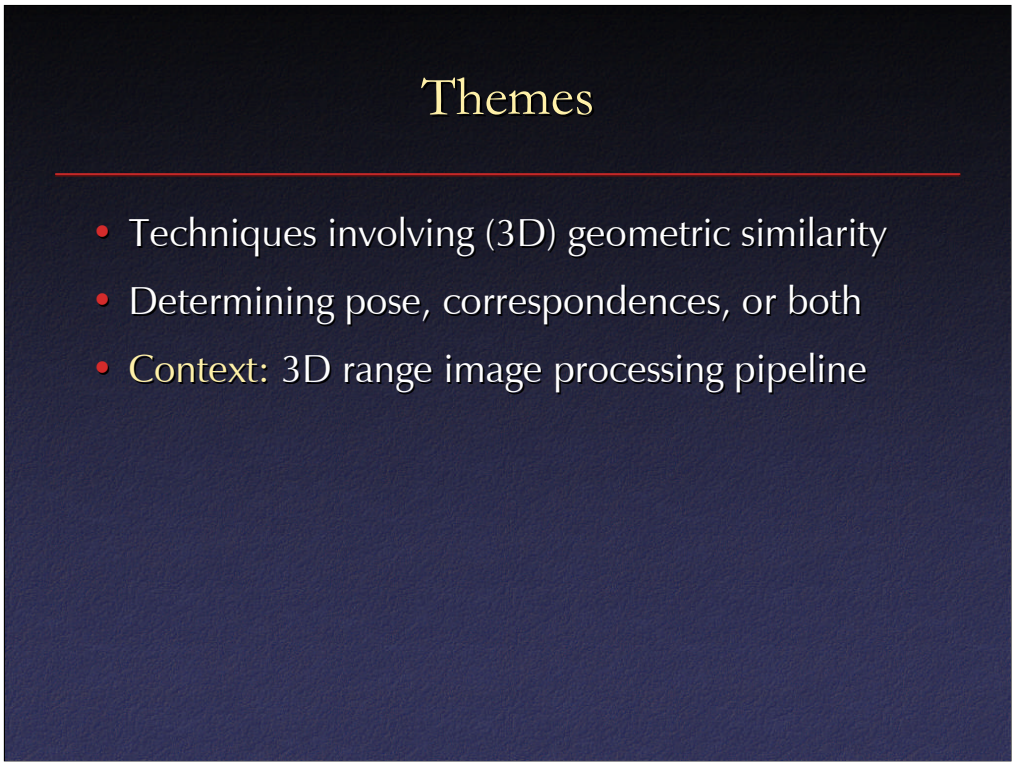
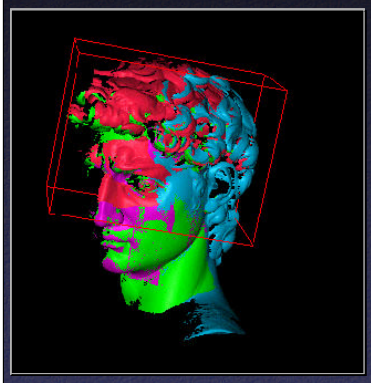
This course covers the topics of local shape matching and 3d registration.



We are specifically targeting this towards 3d modeling applications, in which a set of 3d scans are combined into a single, consistent 3d object. Among the common themes running through the 3 parts of this talk will be techniques for looking at shape similarity (both global and local), and ways of determining pose, point correspondences, or both.

Range Processing Pipeline



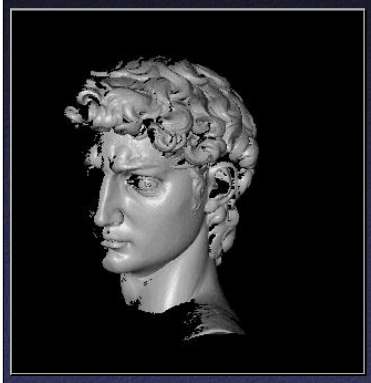
Steps

1. Initial alignment
2. Pairwise alignment
3. Global relaxation to spread out error
4. Merge scans

[Pulli]

We think of these algorithms as forming part of a scan processing pipeline that begins with obtaining an initial guess for each alignment. This can be done with one of the algorithms described in the first portion of the course or, in the worst case, using some sort of manual input.

Range Processing Pipeline



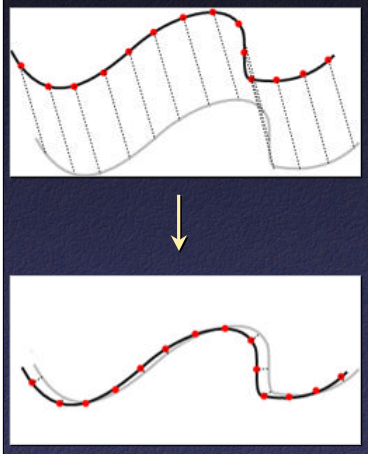
Steps

1. Initial alignment
2. Pairwise alignment
3. Global relaxation to spread out error
4. Merge scans

[Pulli]

This is followed by automated accurate pairwise alignment with one of the neighboring scans using one of the methods we'll discuss, such as the "ICP" or Iterative Closest Points algorithm.

Range Processing Pipeline



Steps

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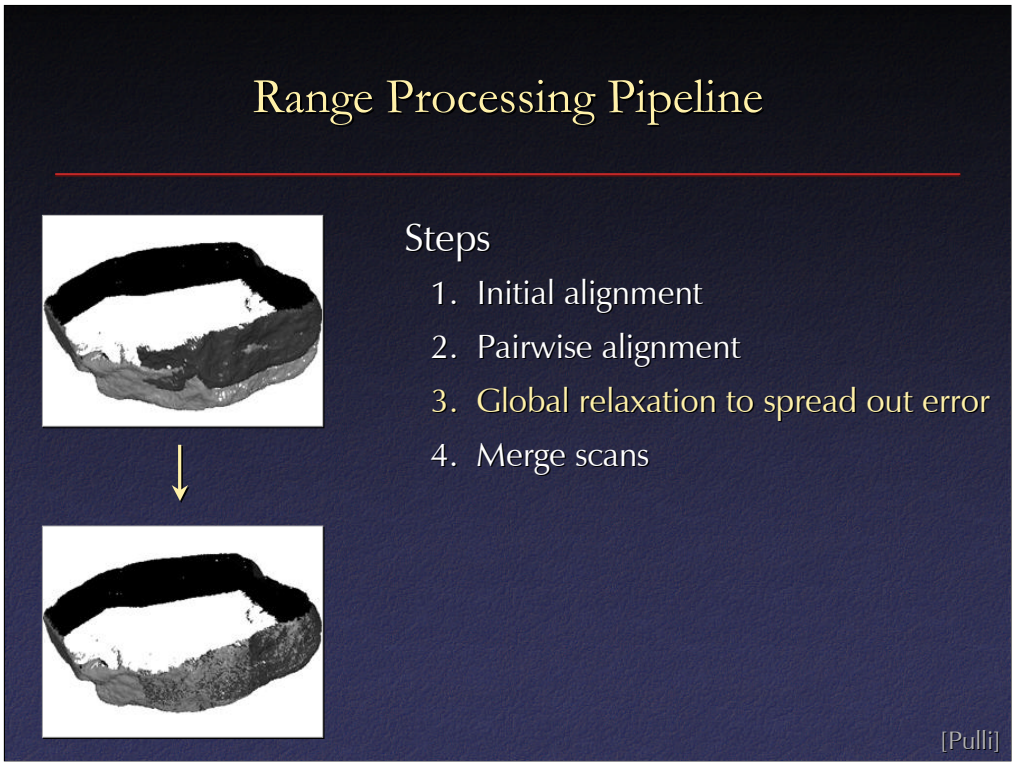
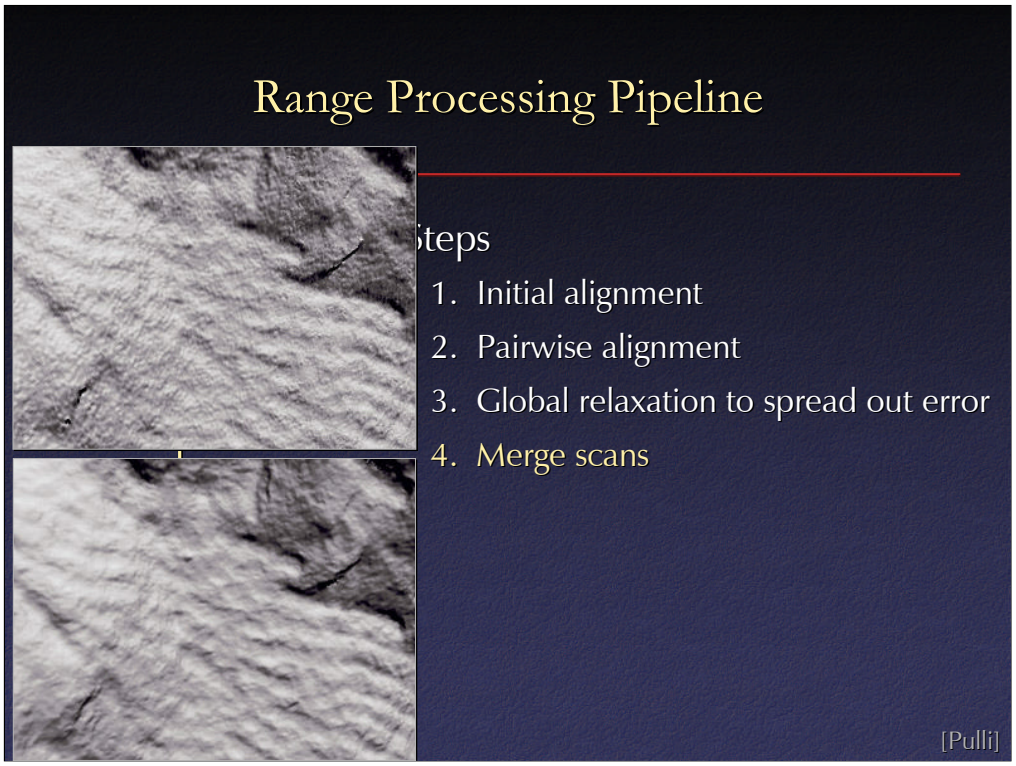
As we'll see, ICP operates by picking points on one scan, computing "corresponding" points on the other (usually just the *closest* points, hence the name), and minimizing their distance. This process is *iterated* until convergence.



There's a problem with just aligning each scan to one other, though. Consider this situation in which we have a chain of scans stretching all the way around an object. At top, we've aligned each scan to the one immediately before it. However, because of noise, miscalibration, or some other cause the final scan is quite a distance away from the first one. So, we need some method of "spreading out" the alignment error, so it's not concentrated in just one pair of scans. This is the goal of so-called "global registration" algorithms, which we'll also cover in this part of the course.



The final stage is to merge all the scans together (which we're not really covering in this course). This gives you a single surface that both incorporates information from all the scans (thus filling the holes typically present in each individual scan) *and*, if you use a good merging algorithm, provides noise reduction by averaging the geometry of the different scans together (thus keeping features while averaging out the noise).

Schedule

1. 3D Shape Matching – Michael Kazhdan

Break

2. Rigid-body pairwise and global alignment – Szymon Rusinkiewicz
3. Non-rigid global alignment for large scans – Benedict Brown