Acquisition of Kinematic Structure and Description of Complex Human Motion

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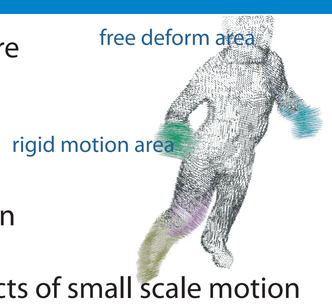
Acquisition of Kinematic Structure

Bottom-up model generation

Acquire kinematic structure from observed motion without speciffc model

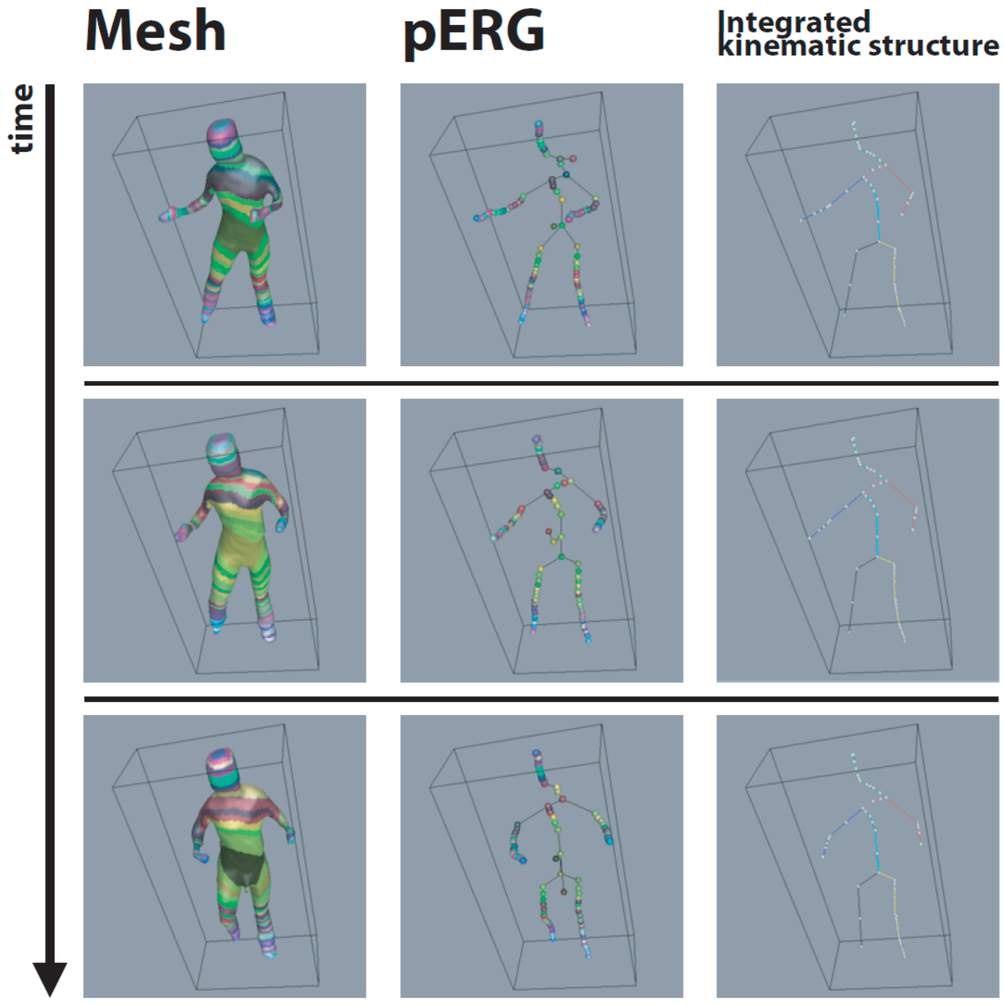


Global shape description by Reeb Graph

Design a global description for shape structure so as to eliminate the effects of small scale motion

Model generation at toplogically coherent intervals

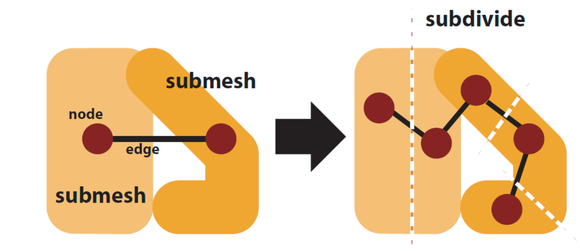
Separate the entire time series data to topologically coherent/incoherent intervals, and acquire a kinematic structure only from the topologically coherent intervals



Algorithm

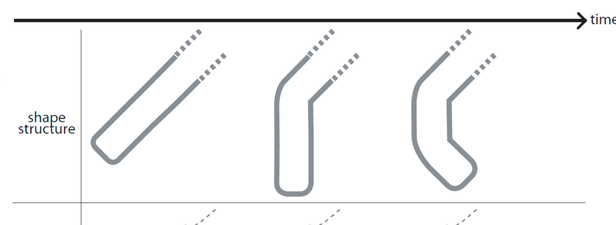
Construct pseudo Endoskeleton Reeb Graphs (pERG) Throughout the volume data sequence .

1



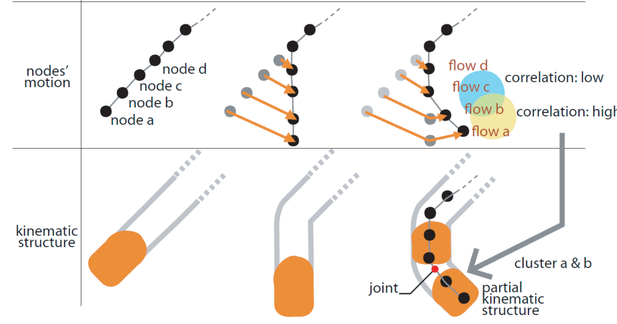
Separate the time series of pERGs to different time intervals which are topologically either coherent or incoherent.

2



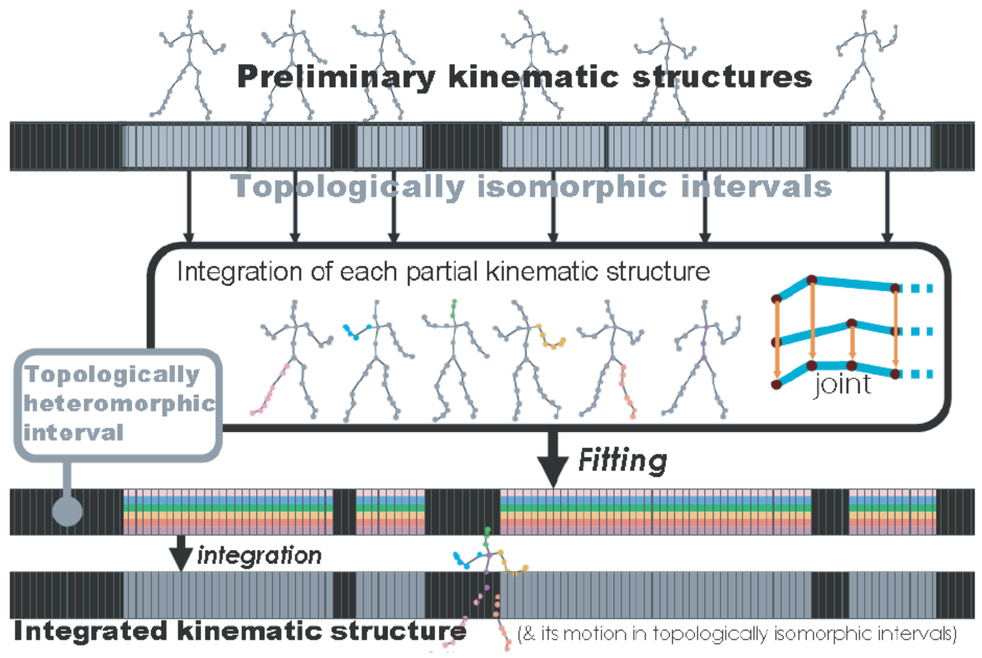
For each topologically coherent interval, cluster nodes of the Reeb graph based on their motion, and acquire a kinematic structure (preliminary kinematic structure).

3



Integrate the preliminary kinematic structures.

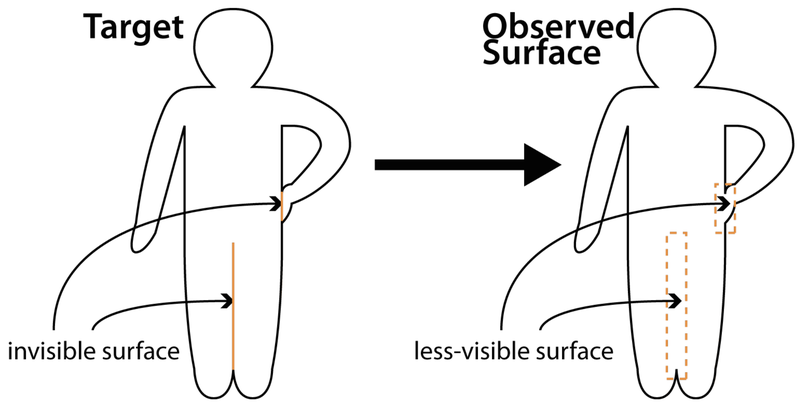
4



Description of Complex Human Motion

Complex Human Motion

We estimate complex human motion from 3D video.
We base our algorithm on a model-based approach
which uses a complete surface mesh of a 3D human model to be matched with 3D video data.
This type of method usually works well against partly incomplete input data,
however fails to estimate what we call ``complex motion'':
where some parts of the body touch each other for a long period.
This touching deteriorates the visibility of the neighbouring surface, which causes matching failures.

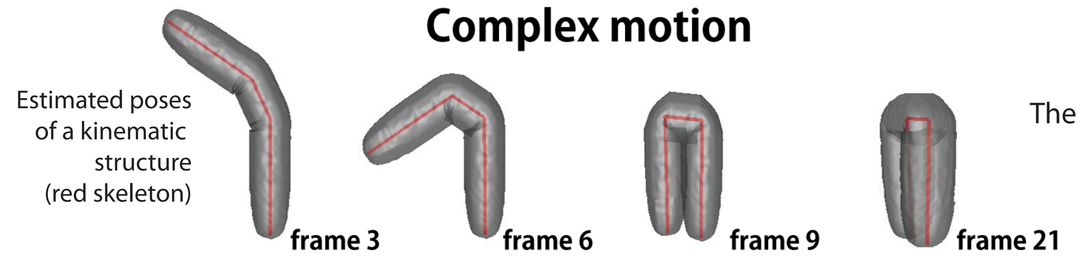


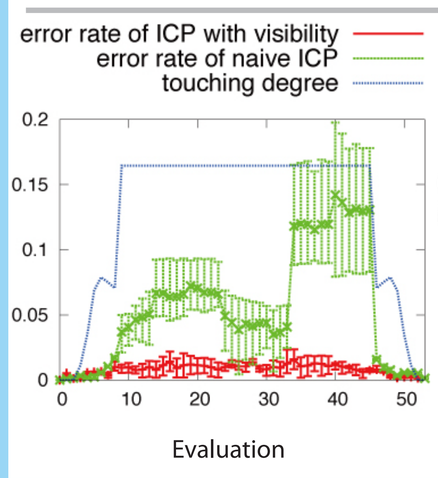
Visibility based Approach

We introduce a ``visibility'' measure'' for each mesh vertex that represents how it is occluded or missed on the observed surface.

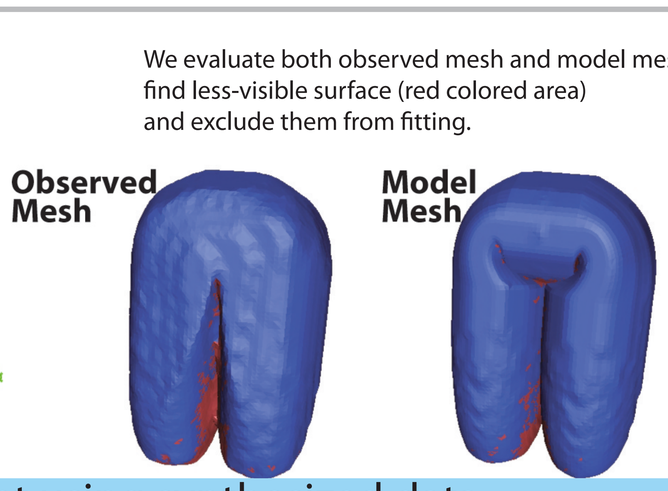
The ``visibility'' selectively suppresses the outliers caused by low observability while traditional ICP algorithms which is a matching algorithm based on nearest neighbour correspondence between vertices on meshes try to find corresponding area for the entire surface and cannot converge to the real posture by definition.
Our algorithm shows improvements over naive ICP algorithm on both synthesized and real 3D video.

Complex motion

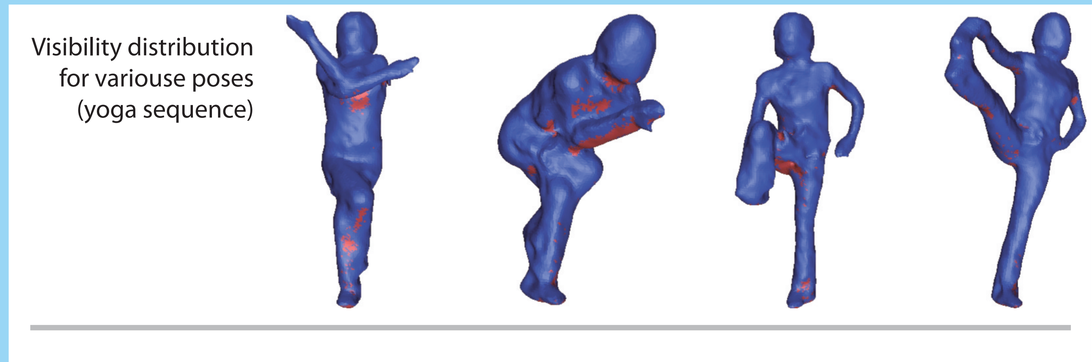


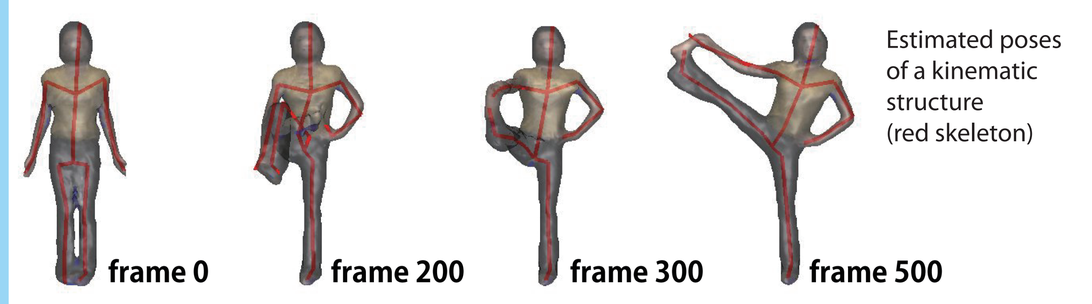


We evaluate both observed mesh and model mesh, find less-visible surface (red colored area) and exclude them from fitting.



Experiment using synthesized data





Experiment using real 3D video

Open Problem & Future Work

- It is not guaranteed that the kinematic structure which reflects the exact structure of the observed object can always be acquired. We plan to set topologically coherent intervals for each branch corresponnding to body segments, and acquire more acculate kinematic structure.
- We plan to focus on "action editing" using acquired pair of kinematic structure and its motion.