Joint Track Machine Learning

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Outline

Motivation

Background

Historical Methods

Aims

References

Motivation

The Problem

- Joints manifest pain during dynamic activity.
- 20% of patients receiving TKA are dissatisfied.
    - Instability, pain, unnatural [1, 3, 11].
- No reliable method of clinically assessing and quantifying joint dynamics.
    - Too much human supervision, too time consuming

Our Proposition

Orthopaedic surgeons and clinicians would readily adopt a practical and inexpensive technology that allows them to measure a patient's knee kinematics during activities of daily living.

PICTURE HERE WITH RX OF KNEE MOTION STUDY

Constraints

- It must fit within a standard clinical workflow
- The technology must utilize equipment commonly found in hospitals
- There must not be significant human supervision nor interaction to generate an examination report.

Background

Projective Geometry

Camera Intrinsics

Model-Image Registration

Historical Methods

Overview

Many different approaches have attempted to solve the model-image registration problem.

- Pre-computed projections
- Skin-mounted motion Capture
- Biplane Imaging
- Iterative Projections

Pre-Computed Projections

- Saving space and memory by pre-computing as much as possible.
- Pre-computed distance maps [12, 9].
- Pre-computed shape libraries [2]

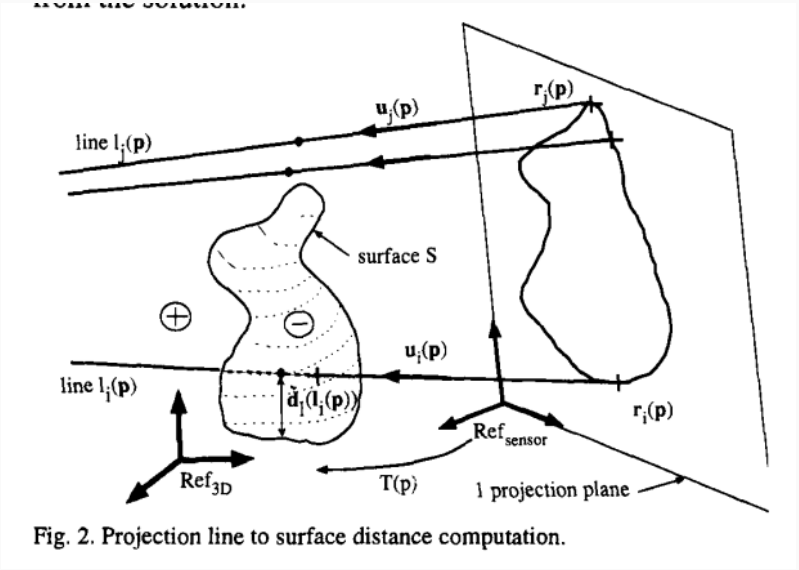
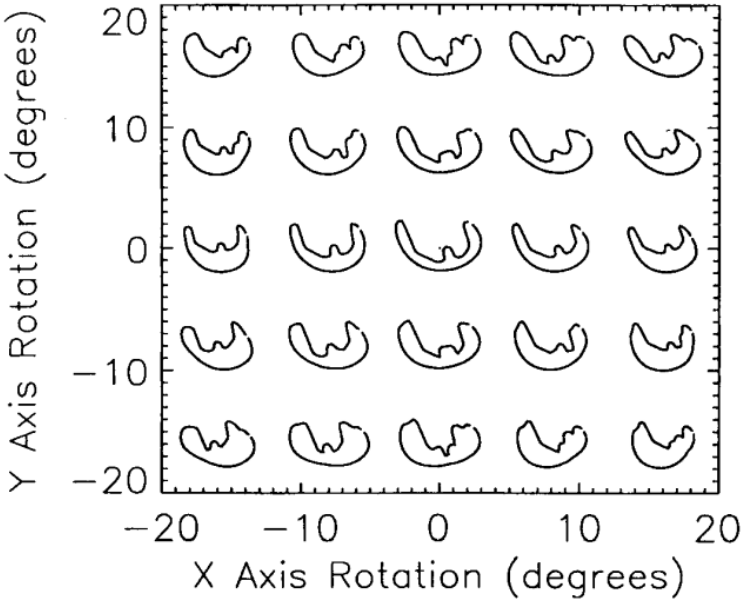


Fig. 2. Projection line to surface distance computation.

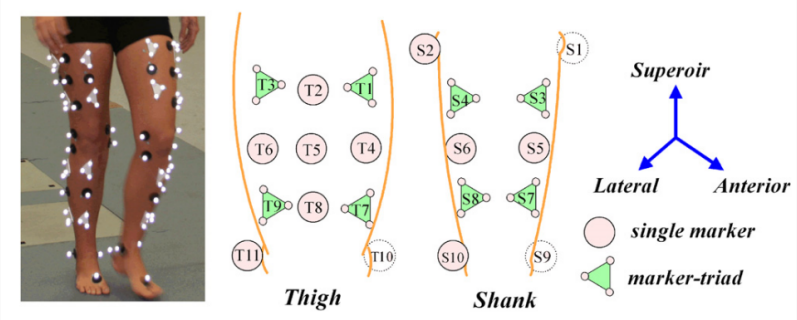


Limitations of Pre-Computed Projections

- Requires an accurate contour from the input image in order to perform calculations.
  - Human supervision vs. inaccuracy.

Motion Capture (MoCap)

- Can measure motion of MoCap beads very accurately.
- Skin-mounted [5, 7, 10].
- Bone pins [8] (any volunteers?).



Limitations of Motion Capture

Skin Mounted

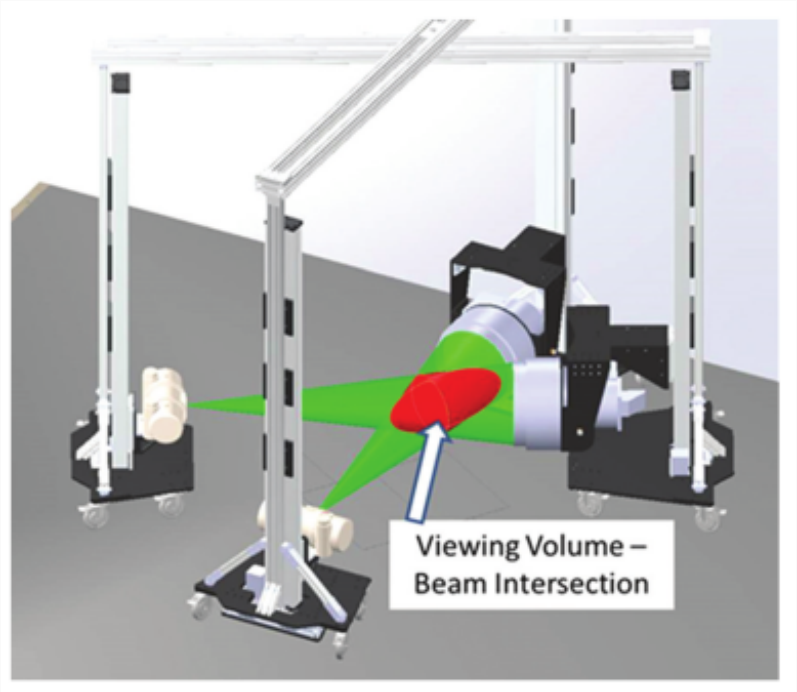
- Doesn't accurately describe underlying skeletal motion with clinical accuracy [5, 7, 10].

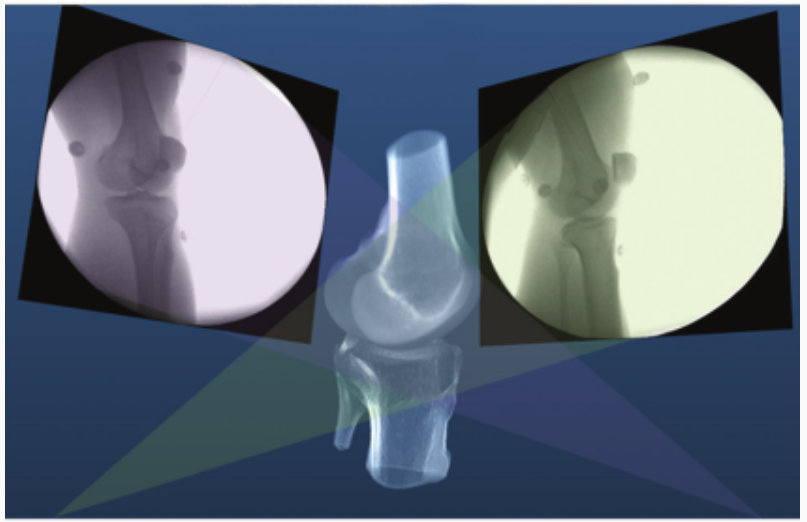
Bone Pins

- Bone Pins
- Need I say more?

Biplane Imaging

- Utilizes multiple cameras to resolve 3D position and orientation[6, 4].
  - Highly accurate.
  - Gold Standard.





Iterative Projections

Model-based Radiostereo Photogrammetry (MBRSA)

Aims

Aims

Aims 1/2
Joint Track Machine Learning and Overcoming Single-Plane Limitations

Aim 3/4
Pilot Trials and Standardized Kinematics Exam

Aim 5
Joint Track Auto Toolkit

Aims

Aim(s)	Goal
1/2	Joint Track Machine Learning and Overcoming Single-Plane Li
3/4	Pilot Trials and Standardized Kinematics Exam
5	Joint Track Auto Toolkit: An Open Source Toolkit for Model-I

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