**A Method for Fast Initialization of Markerless Object Tracking**

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**Vision / Idea**

The vision/idea presented on this poster is interaction with arbitrary objects and assignment of different functionalities to these in virtual environments.

**Motivation:**
- development of an inexpensive Tracking-System
- fast initialization step
- reusability of the reference objects
- interact with predefined objects

**Challenges:**
- high accuracy
- low latency
- huge operational area

**Feature Detection**

**Feature Definition:**
- unique, distinctive picture element
- mathematical properties:
  - scale invariance
  - rotation invariance

**Descriptor:**
- only a local description
- specification of a feature
- important for matching-algorithms

**Matching Algorithm**

Random Sample Consensus (RANSAC) solves an equation with a huge number of outliers, especially in computer vision. The algorithm is stochastic, it is necessary to choose a minimal number of features which describe the model. The resultant assumption with the remaining elements is the homography.

**Homography**

The transformation between two planes is called Homography and is defined as follows:

\[ x'_i = H \cdot x_i \]

rewriting the equation as:

\[ x'_i \cdot H^{-1} = x_i \]

the representation of the cross product can also be written as:

\[ A \cdot h = 0 \]

Equation 3 then can be solved by the single value decomposition.

**Schematic workflow of the offline- and online-phase:**

Offline:
1. initialization with or without a reference marker
2. marking the new object and saving as reference

Online:
3. feature extraction (Speeded Up Robust Features)
4. correspondence search by RANSAC or Least Median of Squares -> homographic transformation
5. rectification of the reference frame
6. absolute/relative pose calculation

**Results**

Performance:
- 4.5 fps on an Intel Core Duo Processor (2 Ghz, 1024 MB)
- 14.16 fps on a Nvidia GeForce 8800 GTX

Accuracy:
Concerning accuracy and radius of movement, the tracker equals the common marker based tracking libraries, except some jitter and infrequent fails of position estimation.

**Future Work**

- evaluation of the interaction in VE
- implementation of a kalman filter
- integration in a VE-Framework
- extend the tracker for 3d-objects

**References:**


**Screenshots of the application**

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