A tracking by detection approach for robust markerless tracking

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Outline

- Introduction
- State of the art
- Markerless tracking by detection
- Summary

Introduction

AR Characteristics

- Combines real and virtual
- Registered in 3–D
- Interactive

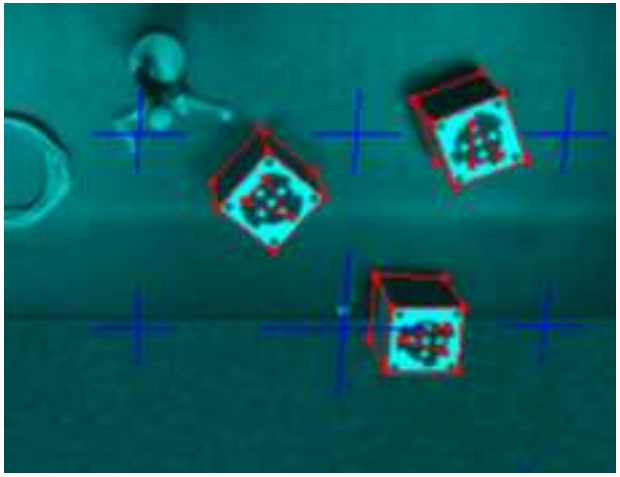
Optical Tracking

- Non-invasive
- Low hardware cost
- Good registration quality
- Support dynamic interaction

Introduction

Marker-based tracking

- Image segmentation
- Object recognition
- Pose estimation



Problem: Sensitive to occlusions

Introduction

Markerless Tracking

- No image segmentation
- AR in natural environment

Challenges

- Invariant detection of natural features
- Reliable matching of nature features
- Robust against environment changes
- Reasonable computation complexity
- Accurate pose tracking

State of the Art

Features

- Classical point detectors
  - Harris
  - Shi/Tomasi/Kanade
  - Föstner
- Invariant feature detection/description
  - Affine invariant Harris points
  - SIFT
- Variation/Simplification
  - PCA-SIFT
  - Approximate SIFT
  - SURF

State of the Art

Pose tracking

- Knowledge about the environment
  - 3D Model
  - 2D Plane
- Pose estimation
  - Algebraic
  - Probabilistic
  - Sensor fusion
- Initialization
  - Use markers
  - Use calibrated reference frames
  - Use fixed pose

Markerless Tracking by Detection

- Approximate SIFT for feature detection
- Adaptive SIFT for feature description
- Automatic initialization
- Robust pose estimation based on planar homography
- Simple offline preparation
- Real-time performance

Markerless Tracking by Detection

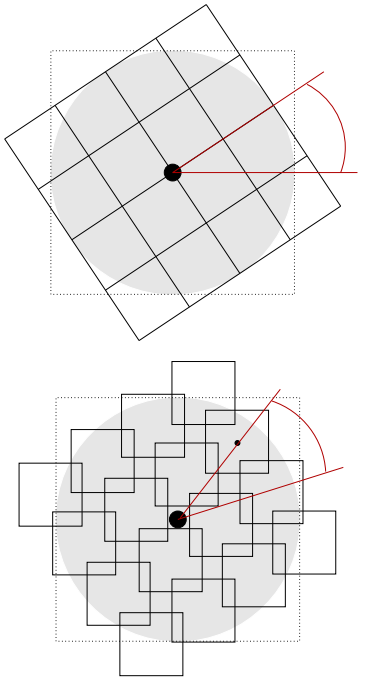
Approximate SIFT detector

- No doubling of the image size
- Difference-of-Mean (DoM) instead of Difference-of-Gaussian (DoG)
- Integral image for fast calculation of DoM
- Scale space generation with box filter
- No sub-pixel point localization

Markerless Tracking by Detection

Adaptive SIFT descriptor

- Unweighted square
- Rotate only the midpoint of each sub-region
- Fast calculation of the orientation histogram
- Adjustable width of the sample regions
- Adjustable length of feature descriptor



Markerless Tracking by Detection

Pose tracking algorithm

- Use a reference image of the environment
- Define a reference coordinate system
- Establish 2D correspondences
- Compute a homography
- Robust 3D pose estimation

Markerless Tracking by Detection

Tracking results




Markerless Tracking by Detection

Tracking & Augmentation

Summary

What we have shown . . .

- Challenges of markerless tracking
- State of the art
- The approach of tracking by detection

What we are going to do . . .

- Performance improvement and evaluation
- Tracking by both detection and prediction
- Tracking in large-scale environment

Thank You