

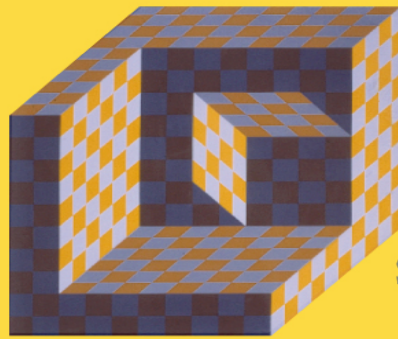


INTERDISCIPLINARY APPLIED MATHEMATICS

IMAGING, VISION, AND GRAPHICS

# An Invitation to 3-D Vision

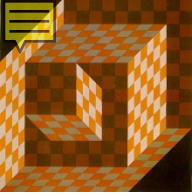
From Images to Geometric Models



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Stefano Soatto  
Jana Kosecka  
Shankar S. Sastry



Springer



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# Lecture 1

## Overview and Introduction

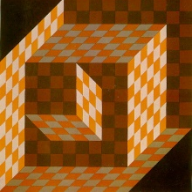


# Reconstruction from images – The Fundamental Problem

**Input:** Corresponding “features” in multiple perspective images.

**Output:** Camera pose, calibration, scene structure representation.





## APPLICATIONS – Autonomous Highway Vehicles

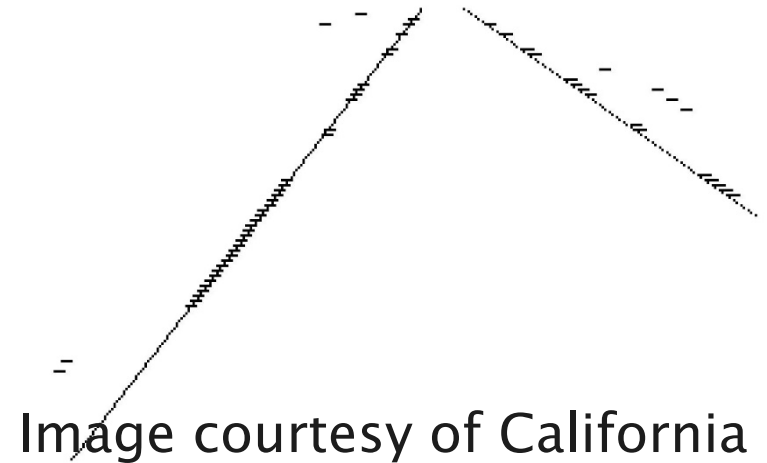
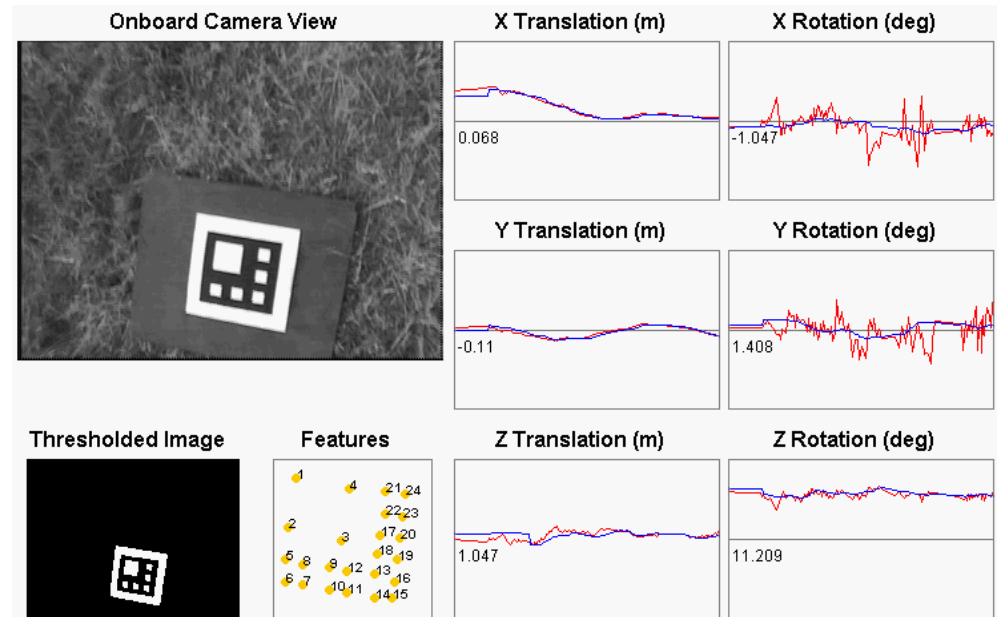


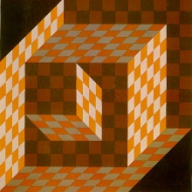
Image courtesy of California PATH

# APPLICATIONS – Unmanned Aerial Vehicles (UAVs)



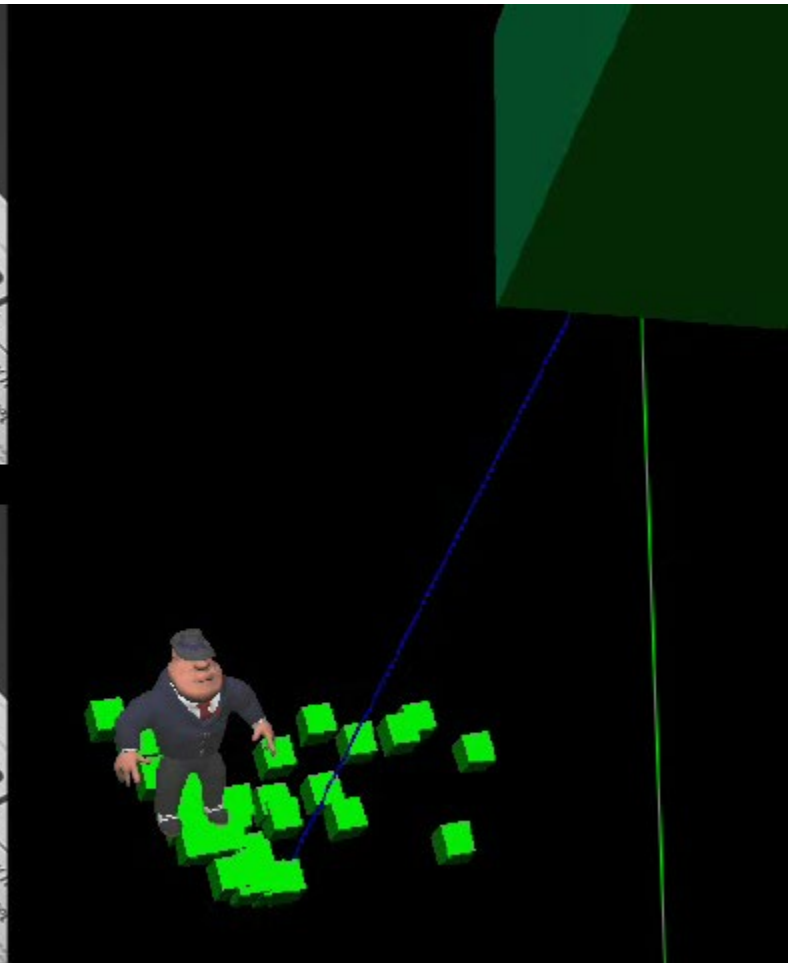
Rate: 10Hz; Accuracy: 5cm, 4°





# APPLICATIONS – Real-Time Virtual Object Insertion

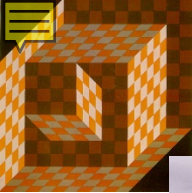
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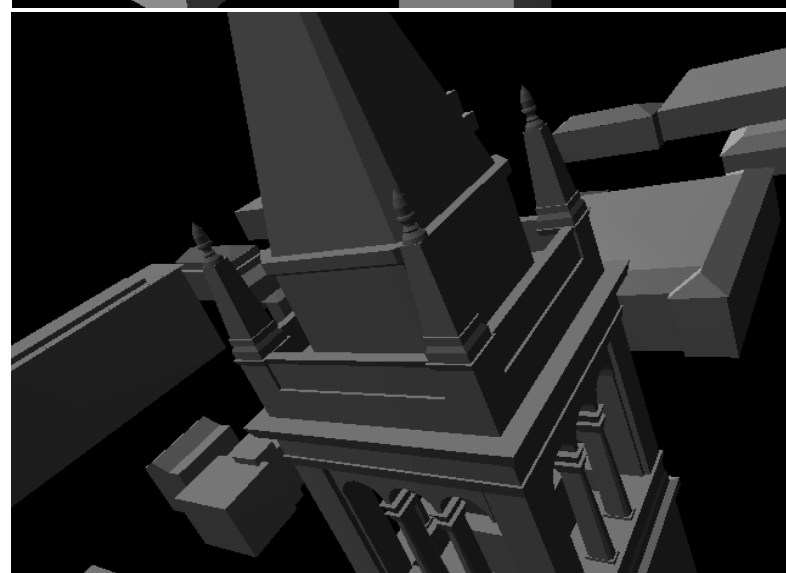
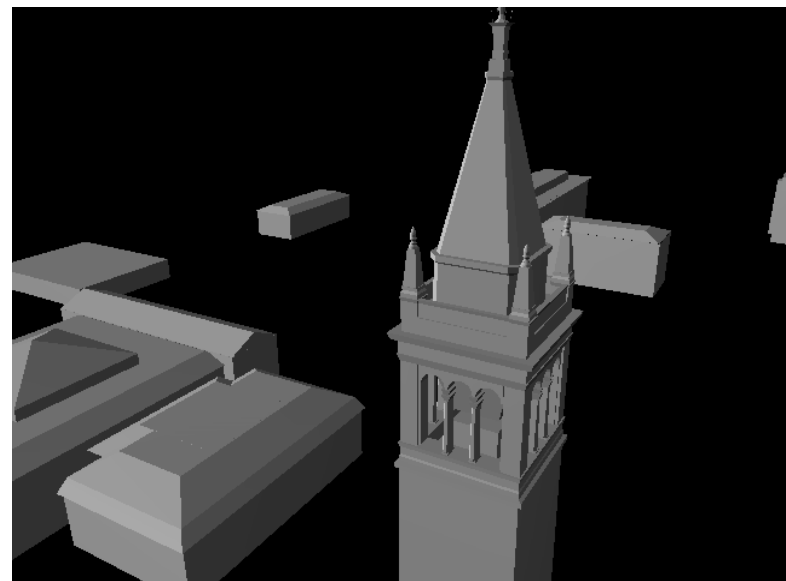
## APPLICATIONS – Real-Time Sports Coverage

### First-down line and virtual advertising

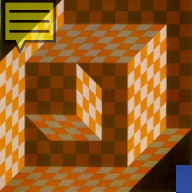




# APPLICATIONS – Image Based Modeling and Rendering

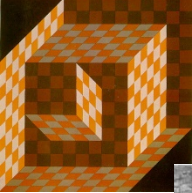






# APPLICATIONS – Image Alignment, Mosaicing, and Morphing





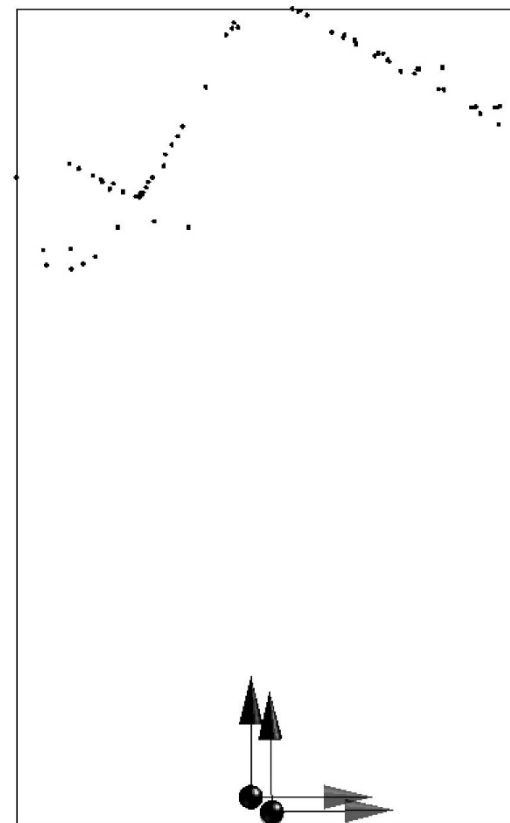
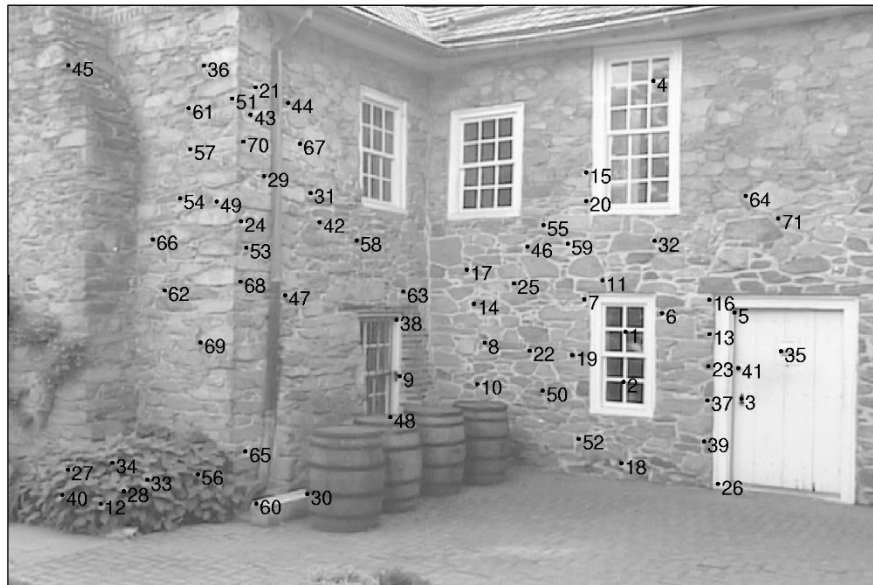
# GENERAL STEPS – Feature Selection and Correspondence



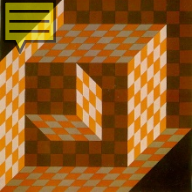
1. Small baselines versus large baselines
2. Point features versus line features



# GENERAL STEPS – Structure and Motion Recovery

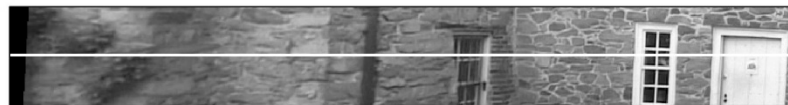
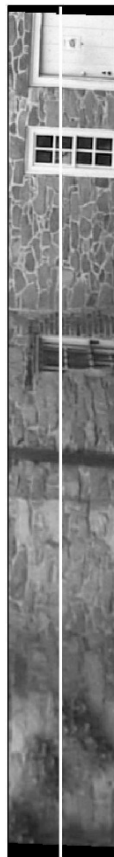


1. Two views versus multiple views
2. Discrete versus continuous motion
3. General versus planar scene
4. Calibrated versus uncalibrated camera
5. One motion versus multiple motions



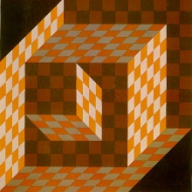
# GENERAL STEPS – Image Stratification and Dense Matching

Left



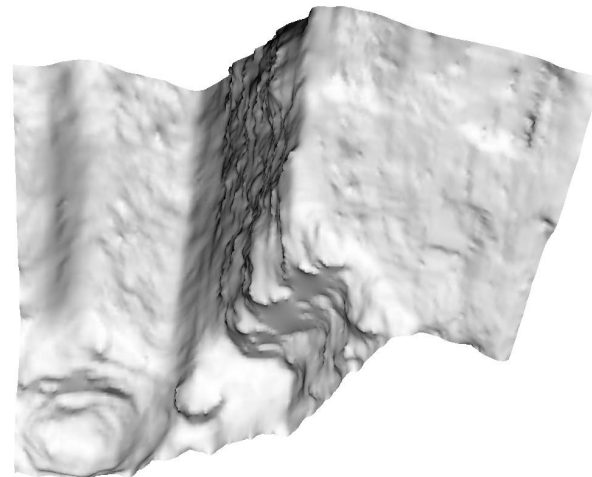
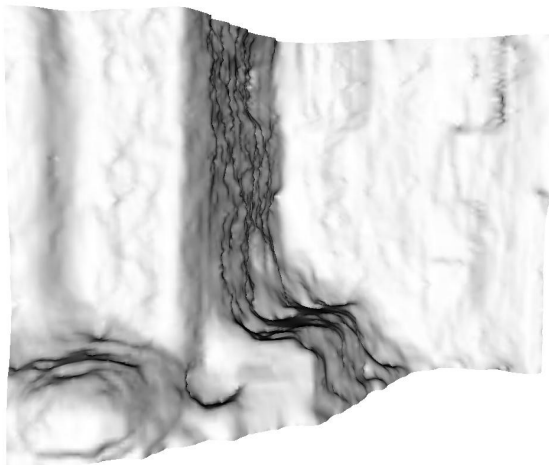
Right





# GENERAL STEPS – 3-D Surface Model and Rendering

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1. Point clouds versus surfaces (level sets)
2. Random shapes versus regular structures