

Practical Camera Calibration for Large Rooms

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Introduction

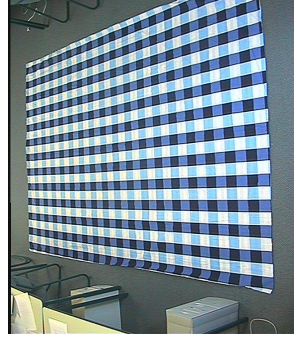
- ❑ RoboCup: The All Botz team
- ❑ Camera Calibration
- ❑ Tsai Camera Calibration
- ❑ Sort matching points
- ❑ Evaluation
- ❑ Conclusion

The Problem

- ❑ Can't control what you can't see
- ❑ But also, you must know an objects
 - ❑ Position
 - ❑ Orientation
 - ❑ Velocity
- ❑ Camera calibration:
 - ❑ Map Image Coordinates to Real World Coordinates

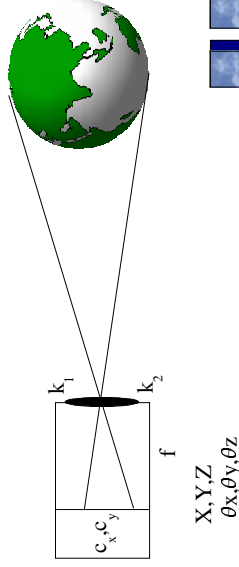
Our Environment

- ❑ Maximum Ceiling (2.5m)
- ❑ View with our camera



The Pin Hole Camera Model

- Point Aperture
- Small lens width
- 11 Parameters (6 External, 5 Internal)



Tsai Camera Calibration

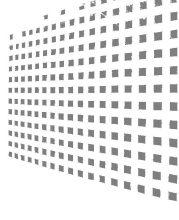
- Camera Calibration is a well known problem in computer vision
- Many different methods have been proposed for the pin hole camera model
- Roger Tsai:
 - LMS approximation of external parameters.
 - Non-linear approximation of radial lens distortion
 - Numerically robust
- Popular, well understood, free implementation

Matching Points

- Pixel *and* real world coordinates of *at least* 12 points
- Rule of thumb: > 20 points
- Matching points
 - Special features in the environment
 - Manually create the points (error prone)
 - Calibration pattern
- Requirements:
 - Accurate, fast, portable, cheap, flexible
 - Duvet cover with back removed

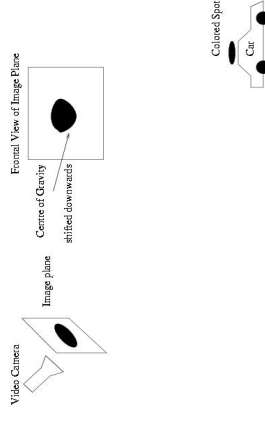
Calibration Image

- Calibration Image after segmentation
- Threshold and remove single pixels (Noise)
- Missing Squares
- Incomplete Squares
- Rotation



Sort Matching Points

- ❑ Select Features of Squares (Corners)
- ❑ Center moves under perspective distortion



Evaluation

- ❑ Evaluated number accuracy vs. number of matching points.
- ❑ In general, accuracy increases with the number of correct points
- ❑ But: one false match can break the model
- ❑ Small set of good points

Conclusion

- ❑ Described a practical, fast, accurate, cheap method for calibrating cameras in large rooms
- ❑ Evaluated the influence of the number of matching points
- ❑ Accuracy is sufficient for our problem ($< 1\text{cm}$)