

## Practical Camera Calibration for Large Rooms

Jacky Baltes  
University of Auckland  
Email: [j.baltes@auckland.ac.nz](mailto:j.baltes@auckland.ac.nz)

## Introduction

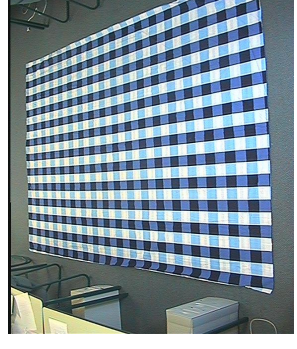
- ❑ RoboCup: The All Botz team
- ❑ Camera Calibration
- ❑ Tsai Camera Calibration
- ❑ Sort matching points
- ❑ Evaluation
- ❑ Conclusion

## 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

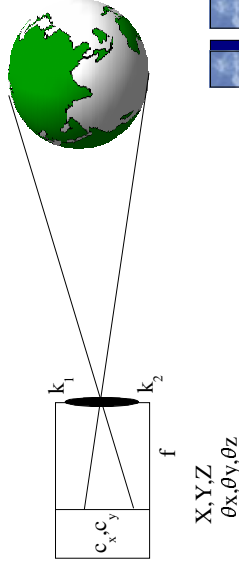
## Our Environment

- ❑ 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

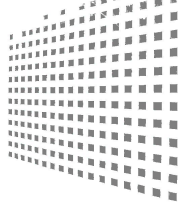
- Camera Calibration is a well known problem in computer vision
- Many different methods have been proposed for the pin hole camera model
- Roger Tsai:
  - LMS approximation of external parameters.
  - Non-linear approximation of radial lens distortion
  - Numerically robust
- Popular, well understood,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

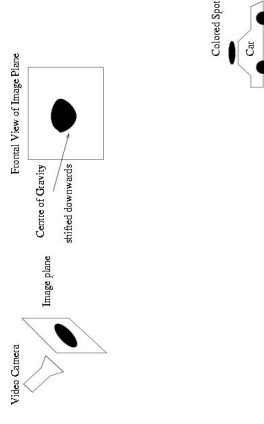
## Calibration Image

- 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 ( $< 1\text{cm}$ )