

Computer Vision

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Lesson 6

Exercises

You have been hired as an engineer to design a system to assist in the production of digital television broadcast of football games. Your job is to design a system that tracks all of the actors on a football field, that is, the players from teams A, team B and the referees. Your system employs a network of cameras mounted above the stadium. The field of view of the cameras is such that every part of the playing field is observed by at least one camera. Your problem is to track the ball, the players and the referees, and to project their positions onto common reference frame representing the playing field.

The field has been painted with a grid of dashed white lines every 10 meters. The pattern of dashed lines makes it possible to uniquely identify each grid line. This grid makes it possible to calibrate a homographic transformation for each of the cameras.

1) For each camera, you must calibrate the homography that transforms the position of each actor onto his position on the playing field. You are given a list of intersections points for the calibration grid. Each point is identified by its image position P^i and by its playing field position P^s . Explain how to calculate the homography for each camera. How many points are necessary? Is it possible to use more than the minimum number of points?

2) The colors of the actor's uniforms make it possible to classify them as a player for team A, team B or a referee. Explain how to use histograms to classify each actor as being a referee or a member of team A or team B. How can you initialize the histograms? How many cells should you use? How can you calculate the position and size of each actor. How can you determine a confidence factor for each classification?

3) Explain how to follow the trajectory of each actor with a Kalman Filter. What is the state vector. What is the equation for predicting the state and its precision? What is the equation for predicting the observation? How can you provide a Region of Interest (ROI) for detecting each actor. What can you do if there is more than one actor in a ROI? How can you update the list of positions? How can you initialize the tracking? What can be done when a predicted tracker is not found.

4) The game ball is white (the same color as the calibration grid). It cannot be detected by its color. In addition, the game ball moves very fast. Explain how to use a vector of receptive fields to find the game ball.