Bring it to Pitch: Combining Video and Movement Data to Enhance Team Sport Analysis

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Player Detection

- Domain Task
  - Integrate appropriate analytical visualizations within the video context
- Hardware Limit
  - One main camera positioned on side of the pitch for tactical view
- Key Requirement
  - Extract data from standard video recording
  - Allow user to overlay visualizations on the video material

Soccer Game Analysis

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How to analyze the video?

- Region-based Analysis
  - Interaction spaces and free spaces
  - Dominant region
- Event-based Analysis
  - Shot on goal, cross and pass
  - For the team, the aim is to lower the risk of pass
  - Passing behavior of each player

Player Detection

- Challenge 1: To allow zooming, the focal length can be different in different frames. And players on the opposite side appear smaller.
- Challenge 2: Body pose, proportions and imaging conditions.
- Low-level appearance models. Perform the player contour analysis through color histograms.
- Require only minimal characteristics about the search object, making it adaptive to more videos.

Panoramic View

- Input: A set of overlapping images
- Align images; Extract and match SIFT (Scale-invariant feature transform) features
- Homography—A transformation matrix acting on projective image coordinates

Visual Analysis—Complete and Efficient

But I only see part of the pitch...

A Single Frame from a Soccer Match Video

Sample Visualization

In this presentation...

- How designers think from the domain perspective?
- How to visualize from several frames in videos?
- Some techniques applied to this visualization.
- What to do to make the system more applicable?
<table>
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<tr>
<th><strong>Assessment</strong></th>
<th><strong>Insights from Expert</strong></th>
<th><strong>Challenges from Implication</strong></th>
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<tbody>
<tr>
<td>• Position Difference: Average &lt; 2m Standard Deviation 0.5m</td>
<td>• natural</td>
<td>• Real-time analysis</td>
<td>• Clearly analyze the domain problem.</td>
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<tr>
<td>• Time to generate a panoramic view: 40-50 seconds on average, depending on the size of the view.</td>
<td>• advanced in terms of application in practice</td>
<td>• Inaccuracy from distortion etc.</td>
<td>• Integrate the visualization with original video stream</td>
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<td></td>
<td>• make the invisible visible</td>
<td>• Potential problems: overplotting, contrast effect or distraction caused by non-match information in the video</td>
<td>• Consider the practical engineering requirement</td>
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<td>• high refresh rate of free spaces</td>
<td>• How to match the most interesting area?</td>
<td>• Making the analysis results objective</td>
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<td>• can dot represent real person?</td>
<td></td>
<td>• Avoid interference with analysis of domain experts</td>
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</table>

**Summary**

- Clearly analyze the domain problem.
- Integrate the visualization with original video stream
- Consider the practical engineering requirement
- Making the analysis results objective
- Avoid interference with analysis of domain experts
- That’s what we can learn from this paper

But soccer is a 3D game and full of imagination…

Thanks