Inertial Sensor-Based Approach for Shot/Pass Classification During a Soccer Match

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Introduction

Motivation

Performance indicators in soccer [1]

- Total number of shots
- Total number of passes

→ Need for assessment tools

State-of-the-Art

Performance assessment in soccer [2]

- Video analysis
- High costs and low portability

→ Mainly applicable for elite teams

Our Goal

Shot/pass classifier

- Inertial sensors
- Pattern recognition methods

→ Low-cost solution for amateur teams

Data Collection

Hardware Setup

Sensor unit

- Located in soccer shoe cavity
- Accelerometer (±16 g)
- Gyroscope (±2000 °/s)
- Sampling rate: 1000 Hz

Storage unit

- Located in shin guard
- SD card (2 GB)

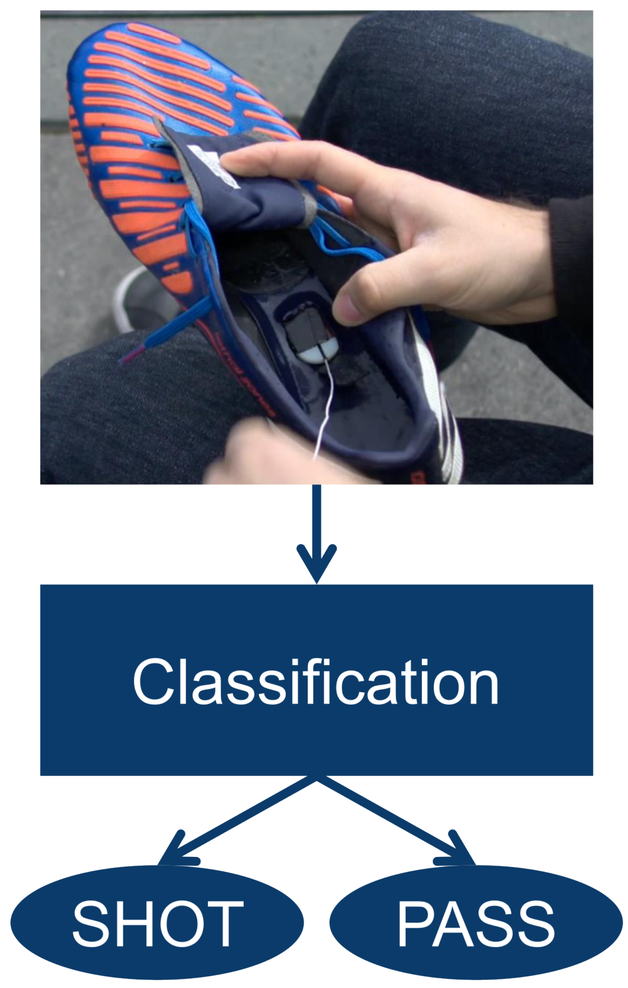
Study Setup

Study A

- Controlled exercises, e.g. dribbling-pass-shot
- 11 equipped amateur players

Study B

- 11 vs. 11 game (60 minutes)
- 17 equipped amateur players



Methods

Pattern Recognition Pipeline

1. Peak detection
   - Butterworth high-pass filter
   - Signal magnitude vector
   - Absolute difference (left and right shoe)
2. Segmentation (1 s)
3. Feature extraction (in total: 48)
4. Event leg classification
   - LEFT/RIGHT
   - Support Vector Machine (linear kernel)
5. Hierarchical event classification
   - SHOT/PASS/OTHER
   - Support Vector Machine (linear kernel)

Evaluation

Study A: parameter selection/classifier training

Study B: testing complete system (1. - 5.)

- Balanced accuracy
- Ground truth: video labeling

Results & Discussion

Confusion Matrix

	PASS	SHOT	OTHER
PASS	**227**	2	131
SHOT	51	**13**	5
OTHER	58	3	**3445**

Columns: ground truth, rows: prediction

Balanced Accuracy

PASS/SHOT vs. OTHER:	89.5 %
PASS vs. SHOT:	84.2 %
PASS vs. SHOT vs. OTHER:	78.7 %

Discussion

– Problem of imbalanced data

– SHOT/PASS labeling in games challenging

\+ Adequate OTHER removal

\+ Generic approach, applicable for e.g. crosses

Summary & Outlook

Video-based performance assessment tools mainly for elite teams

Provision of a low-cost solution for amateur teams

Balanced accuracy: 78.7 %

In future: personalized system with online learning

Acknowledgment & References

This work was supported by the Bavarian Ministry for Economic Affairs, Infrastructure, Transport and Technology and the European fund for regional development.

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