

Injury Mechanism Classification in Soccer Videos

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Motivation

- **Catastrophic injuries are very evident and immediate action can be taken.**
- **However, certain clash/falling/fatigue can lead to underperformance of the player effecting the team performance, sponsor and the state as a whole.**

Can such situations be detected by video analysis for timely action e.g. player substitution?

Outline

- **Introduction**
- **Literature**
- **Challenges**
- **Solutions**

Player injury in Soccer matches

- Soccer is very popular sport, but also has highest injury rate [1] than any sports, including rugby.
- Serious problem for the player, the team, the club, and for society at large.
- Generally, 50-80% of soccer injuries occur at the feet and legs, head injuries account for 4-22%, concussions are usually rare making up to 2-3% of all soccer injuries.

[1] P. Wong and Y. Hong. Soccer injury in the lower extremities. British Journal in Sports Medicine, 2005.

Causes of injuries [2]

- Intrinsic (self-inflicted) factors – Individual, biological or psychological attributes for example previous injury, stress level, inadequate rehabilitation after injury etc.
- Extrinsic (external) factors – The role the environment plays such as foul play, physical activities involving sudden forced impact on the body due to another player or object, collision when jumping and landing, wears such as shoes with cleats for better grip on the turf.

[2] V. Valderrabano *et al.* Foot and ankle injuries in professional soccer players. Sports Orthopaedics and Traumatology, 2014

Applications

- Injuries are usually identified by questionnaires, video records, doctor or physiotherapist examination and player confirmation.
- Post-injury. Medical treatment and rehabilitation
- Pre-injury. Training program to avoid fouls, improper tackles, jumping and landing, balancing exercises, training certain muscles to stabilize joints, etc

e.g. FIFA 11+ warm-up training program [3]

[3] T. Soligard *et al.* Comprehensive warm-up programme to prevent injuries in young female footballers: cluster randomised controlled trial. *British Medical Journal*, 2008.

Applications

- Teams that underwent FIFA 11+ [3] training program had 30 - 50% less injuries.
- Team performance improvement. Coaches can substitute injured player timely, based on past medical history and current injury details
- Revising Soccer rules/empire decisions.

Injury events (from fouls particularly) detection and analysis can guide to better refereeing. Will also save the reputation of the team, Sponsors and the state!

Video based works

- Andersen *et al.* [4] investigated videotapes and injury information for 313 matches from Norwegian and Icelandic elite football during the 1999 to 2000 seasons.
- Only 57% of actual injuries were identified on the videotapes.
- Systematic video analysis provides detailed information on the mechanisms for ankle injuries in football

[4] Andersen *et al.* Video Analysis of the Mechanisms for Ankle Injuries in Football. The American Journal of Sports Medicine, 2004

Video based works

- Bjørneboe *et al.* [5] investigated possible injury incidents from the 2000 season to the 2010 season in Norwegian male professional football using video analysis.
- After studying nearly 414 matches, they found 1287 incidents;
- Increased rate of non-contact and opponent-to-player contact incidents in both heading and tackling duels.

[5] Bjørneboe *et al.* Video analysis of situations with a high-risk for injury in Norwegian male professional football; a comparison between 2000 and 2010. *British Journal of Sports Medicine*, 2013

Challenges

- **Lot of manual annotations**

Markus *et al.* [6] assessed videos of all professional football injury surveillance videos between 2001 and 2011.

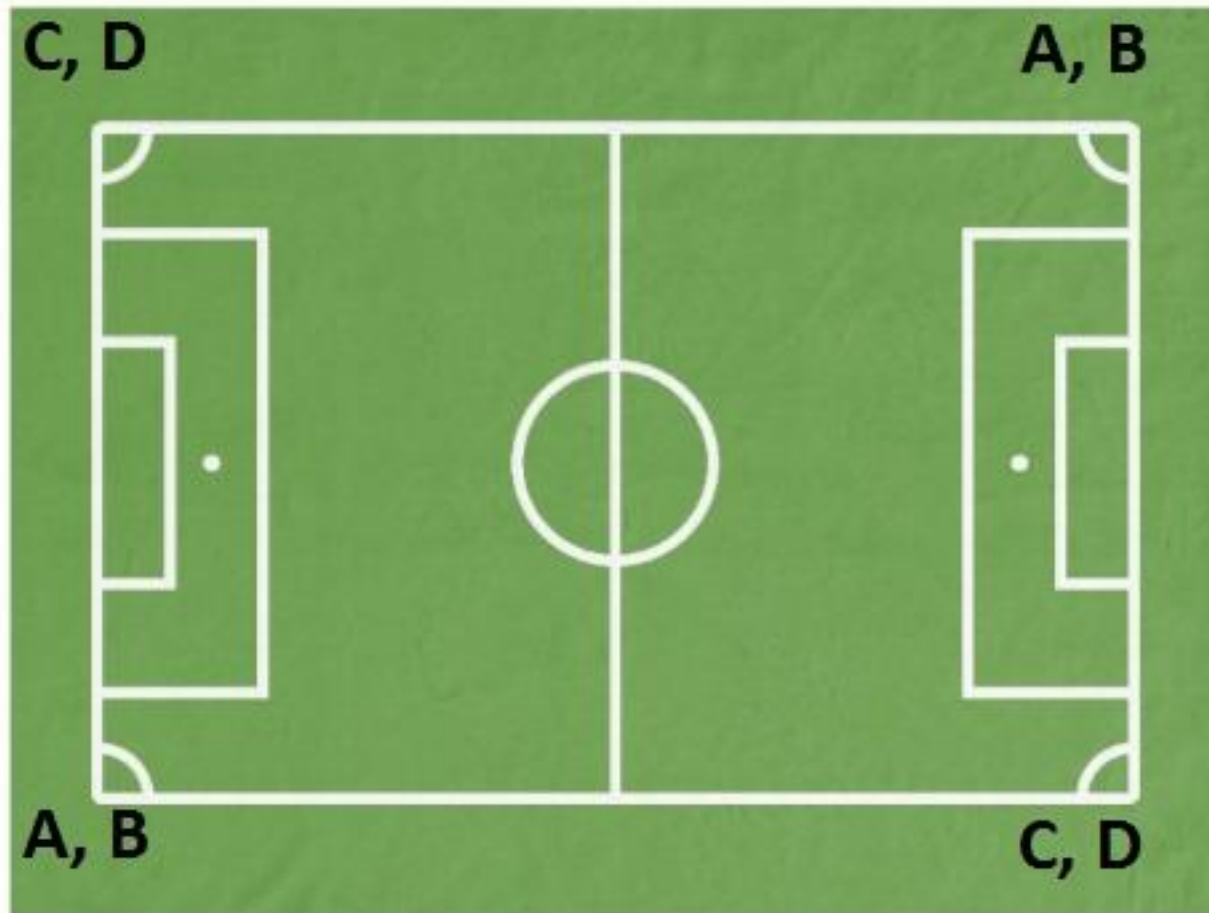
- **Very few samples**

Markus *et al.* found only 39 ACL injuries.

[6] Markus *et al.* Three distinct mechanisms predominate in noncontact anterior cruciate ligament injuries in male professional football players: a systematic video analysis of 39 cases. British Journal on Sports Medicine, 2015

Stage 1 – player falling recognition

Soccer Events Dataset collection

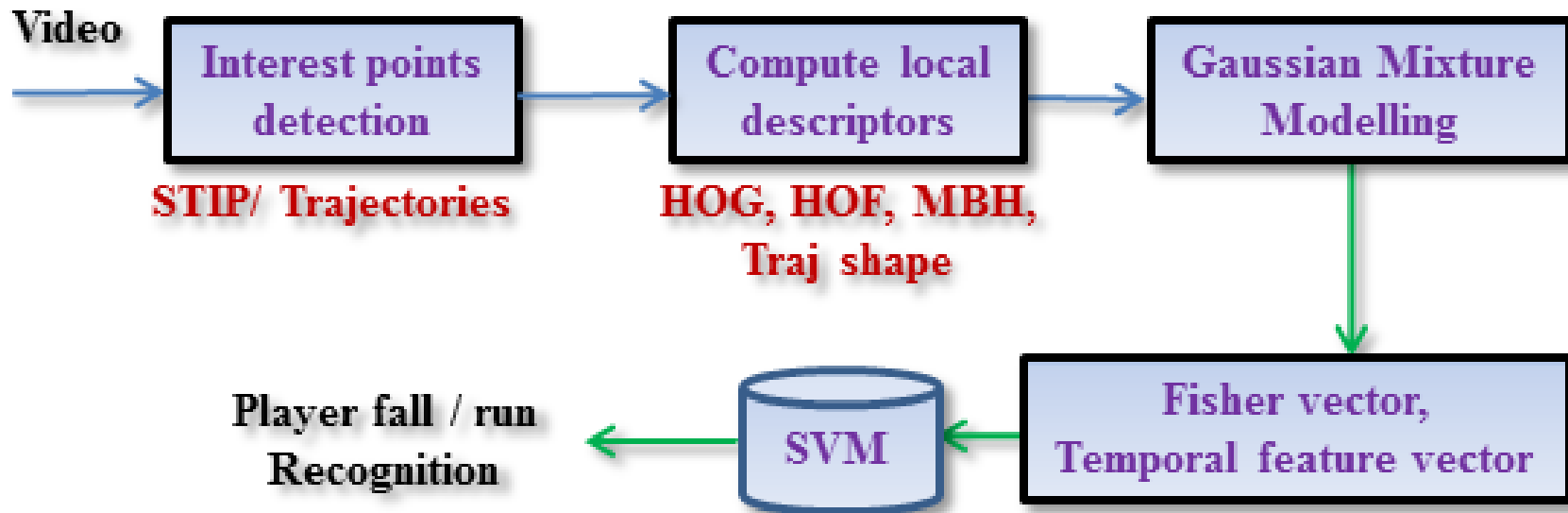


Soccer Events Dataset collection

Event	No. of Samples in Set A	No. of Samples in Set B
Players running	69	68
Player falling	53	50

- **480 Video clips collected from three Australian Women's League Soccer matches (held between November 2013 and February 2014).**
- **High Definition (HD) (1920 x 1080 pixels resolution) cameras were mounted in each corner of the field.**

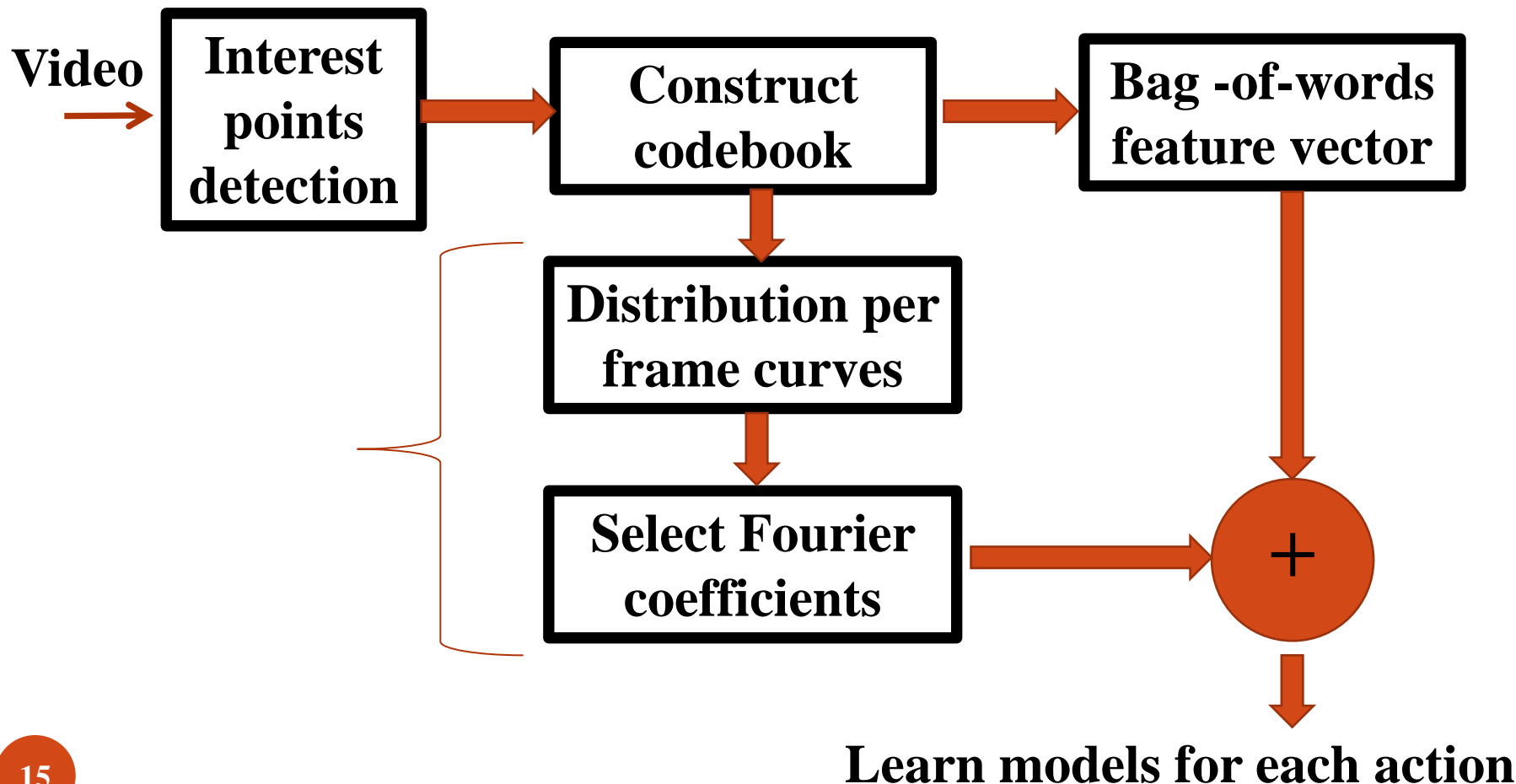
Player Falling Recognition



[7] O. V. Ramana Murthy and R. Goecke. Player falling event detection in soccer videos.

ACM Conference on Knowledge Data and Discovery (KDD) Workshops, Large Scale Sports Analytics, Aug, 2015

Our technique to model temporal information

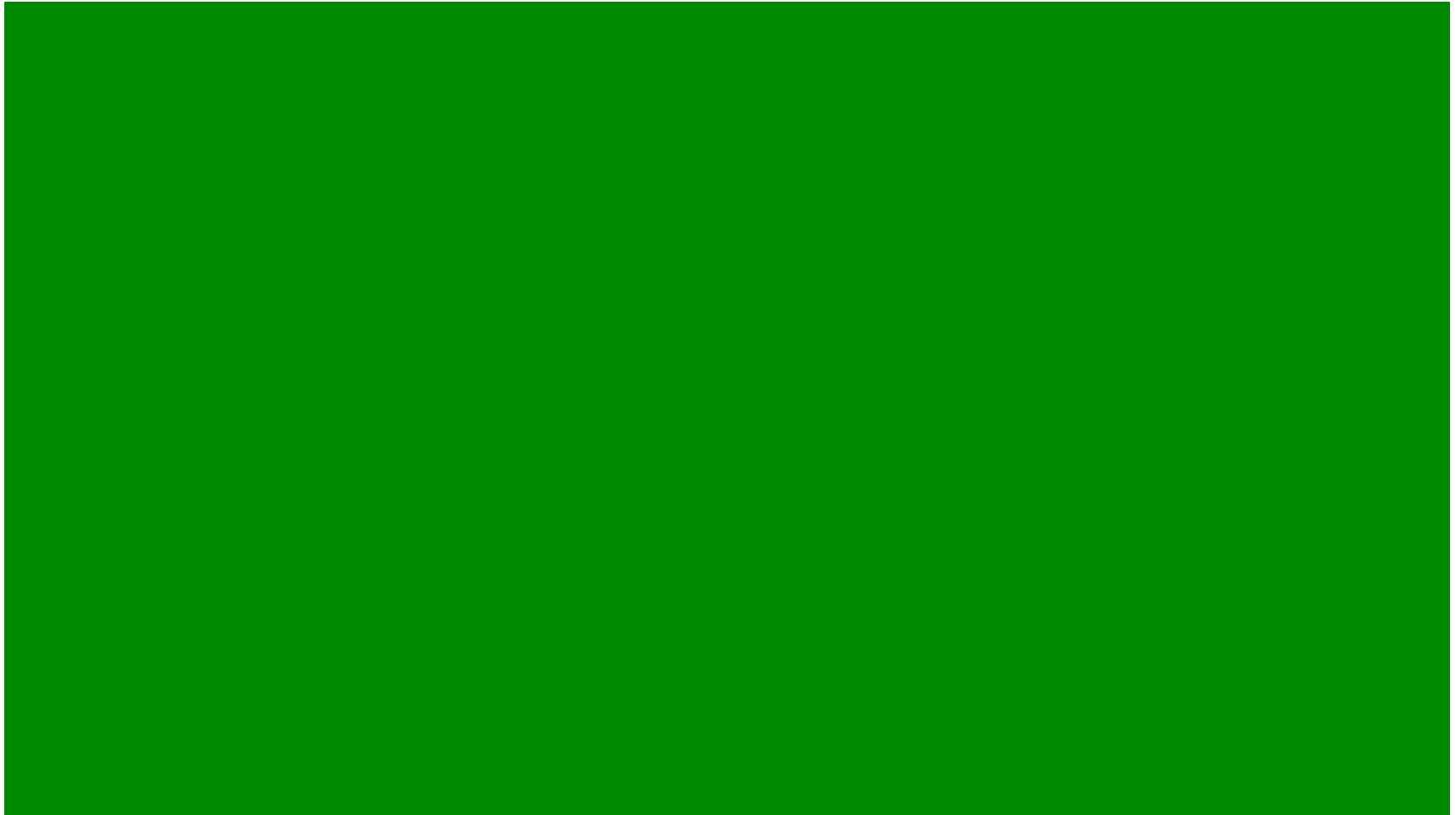


S. No	Approach	Same field of view	Different field of view
A	STIP Fisher vector	75.9%	74.6%
	Dense trajectories	73.0%	68.4%
	Fisher vector		
B	Temporal Feature vector of A	77.1%	69.6%
		77.1%	69.6%
	A+B	82.1%	78.4%
		84.1%	75.9%

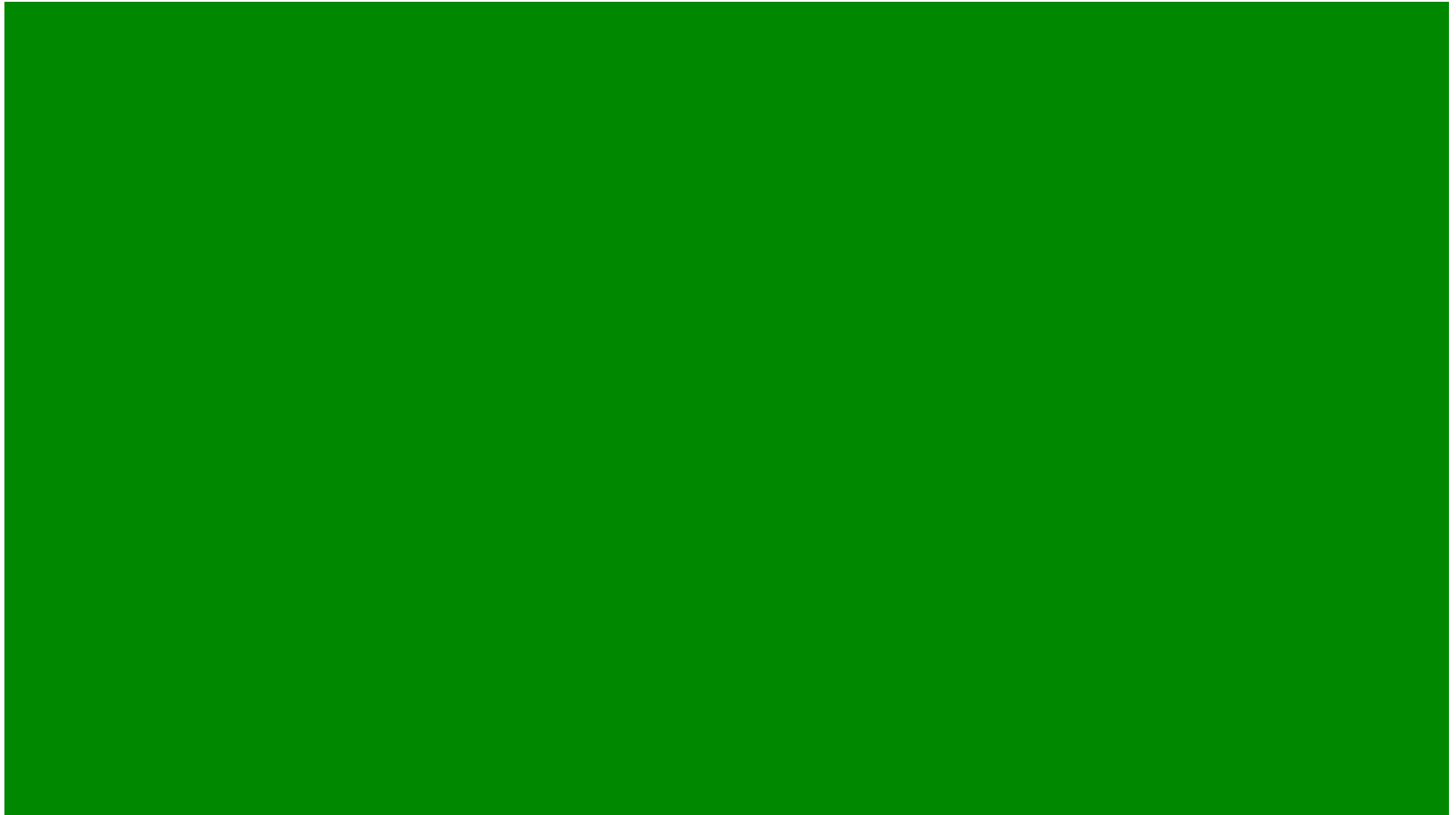
[8] O. V. Ramana Murthy and R. Goecke. The Influence of Temporal Information on Human Action Recognition with Large Number of Classes. DICTA, 2014

Stage 2 – Classifying mechanisms that lead to fall

Injury while Tackling



Injury while Jumping and Landing



Injury Mechanism Dataset

Class	No. of Samples
Tackling	69
Running	53
Twisting and Turning	10
Shooting	12
Jumping and Landing	31
Total	157

Download Link (around 3GB)

<https://drive.google.com/file/d/0ByBHFkIRDnx6a1h0NzJFcTQxcG8/view?usp=sharing>

Injury Mechanism Recognition



5-fold classification accuracy

Approach	Accuracy
STIP Fisher vector	57.4%
Dense trajectories Fisher vector	59.3%

Future work

- **Expand dataset (from FFA)**
- **Localization of falling event in space and time**
- **Coordination with Coaches, trainers and medical professional to identify events that lead to underperformance of the players.**

Thank you