

## Laboratory



### System

- Eight optoelectronic cameras (Vicon Motion Systems)
- Two force plates
- Sixteen markers on pelvis and lower limbs (Vicon Plug-in-Gait lower body model)
- Five additional trunk markers on the sternum, clavicle, C7, T10 and right scapula

### Data collection

- Knee joint moments (frontal, transverse, and sagittal plane) from unanticipated changes of direction at 40-50°

### Data processing

- Hierarchical agglomerative clustering (Ward's linkage method) on knee joint moments through discrete wavelet transform with the Haar wavelet

- **Players split in three clusters:** low-risk (lowest moments), mid-risk (high sagittal and low frontal/transverse plane moments), high-risk (highest moments)

## Football (soccer) field



### System

- Seventeen inertial measurement units (Link, Xsens)
- Full body configuration (upper limbs, head, trunk, pelvis, lower limbs)

### Data collection

- Football-specific exercises with teammates, opponents, and ball (F-EX) and football game (F-GAME)
- Pelvis, hip, knee, ankle joint kinematics (frontal, transverse, and sagittal plane) from unanticipated changes of direction at 30-60°

### Data processing

- One-way ANOVA with hierarchical two-level random effect model based on clusters obtained from knee joint moments in laboratory