Feature extraction

* Importance

1. Analysis the data
2. Develop a classification method

Should be independent from the location, direction and path of the gait

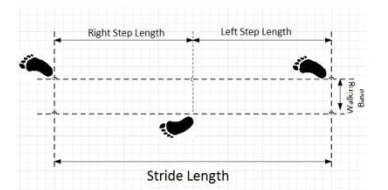
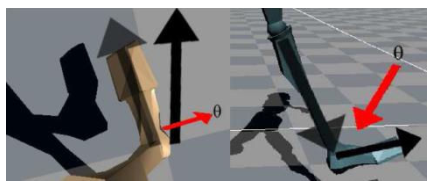
The effect elements for the gait recognition

* Time
* Footwear type
* Walking surface type
* Briefcase carrying condition
* Viewing angle
* Statistic method
* Time varying
* Max & Min

Find the max & 2nd max & min & 2nd min points, including the value and the index. Objects contain: acc, gyro, angle, velocity, position

* Frequency
* Time-frequency
* Wavelet
* time- and frequency-domain signal characteristics
* Trajectory (different type of motion considers different 2D view)
* Features of gait (Hesami et al, 2013)

1. Spatial-temporal: step length, step width, walking speed, cycle time
2. Kinematic: joint rotation of the hip, knee, angle, joint angles of the hip, knee, ankle, thigh, trunk, foot

In this case, the gait parameters prefer to foot orientation and foot angle

* Features of path

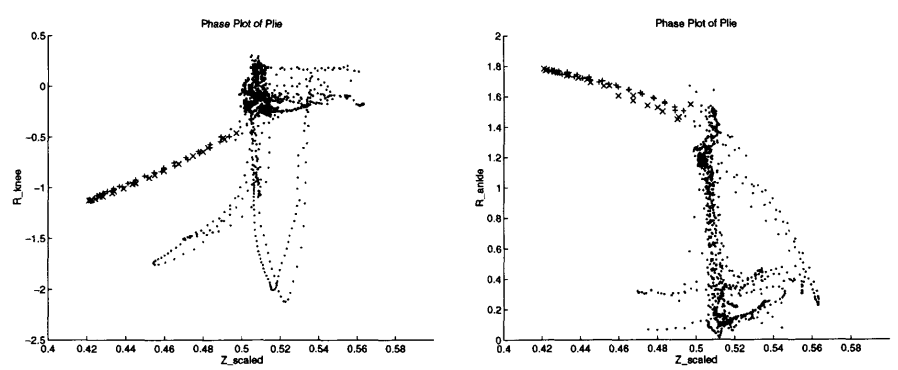
(both in horizontal and vertical view)

The shape of the path: step over --- circle

walk --- straight

run --- zig-zag

* Phase space constraints (Lee et al, 1995)



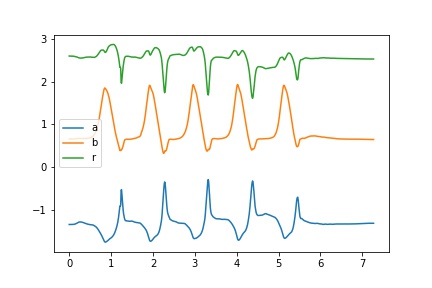
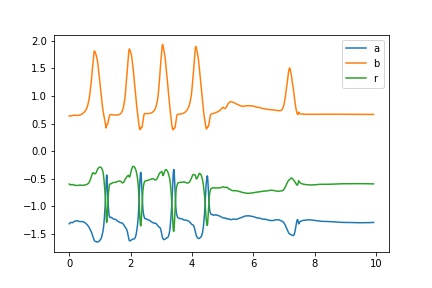
1. joint angles for lDOF joints (e.g. knee)
2. Euler angles for 3DOF joints (e.g. hip)
3. torso orientation
4. body-height-normalized torso height above the floor plane

* Machine learning
* PCA (principal component analysis) / KPCA (Kernel-based Principal Component Analysis)
* SVM (support vector machines)

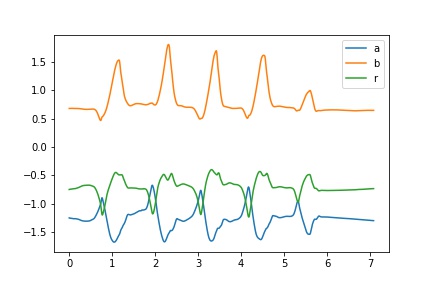
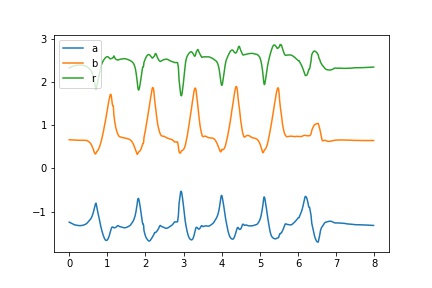
1. 动作列表

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 类型 | 名称 | 编号 | 动作描述 | 组数 | 备注 |
| **无球动作** | | | | |  |
| 走 | 向前走 | 1\_1 | 向前自然走动，6步以上 | 3 |  |
| 向后走 | 1\_2 | 后撤走动，6步以上 | 2 |  |
| 侧面移动 | 1\_3 | 向左右两侧水平移动，6步以上 | 2 |  |
| 走动组合 | 1\_4 | 向任意方向随意走动，20秒以上 | 1 |  |
| 跑 | 向前小跑 | 2\_1 | 向前慢速小跑，8步以上 | 2 |  |
| 向前中速跑 | 2\_2 | 向前中速跑动，8步以上 | 2 |  |
| 向前冲刺 | 2\_3 | 向前冲刺跑，8步以上 | 2 |  |
| 向后小跑 | 2\_4 | 向后自然小跑，8步以上 | 2 |  |
| 后撤步跑 | 2\_5 | 向后撤步小跑，6步以上 | 2 |  |
| 折返跑 | 2\_6 | 向前跑动3步，转身沿反方向跑3步 | 2 |  |
| 转身跑 | 2\_7 | 向前跑动3步，转身向侧方跑3步 | 2 |  |
| 跑动组合 | 2\_8 | 不同跑动类型的随意组合，20秒以上 | 1 |  |
| 跳 | 原地小跳 | 3\_1 | 原地垂直小跳 | 2 |  |
| 原地起跳 | 3\_2 | 原地垂直起跳顶球 | 2 |  |
| 原地前跳 | 3\_3 | 原地向前上方跳起顶球 | 2 |  |
| 跑动前跳 | 3\_4 | 向前小跑过程中向前上方跳起顶球 | 2 |  |
| 拼抢 | 抢位 | 4\_1 | 防守中跟随带球运动员贴身跑动 | 2 |  |
| 抢断 | 4\_2 | 防守中近距离用脚断球破坏 | 2 |  |
| 拦截 | 4\_3 | 防守中拦截脱离对方控制范围的球 | 2 |  |
| **有球动作** | | | | |  |
| 带球 | 脚弓向前带球 | 5\_1 | 脚弓带球向前跑动，4步以上 | 3 |  |
| 脚背向前带球 | 5\_2 | 脚背带球向前跑动，4步以上 | 3 |  |
| 变相带球 | 5\_3 | 连续带球变相跑动，10秒以上 | 3 |  |
| 传球 | 原地向前短传 | 6\_1 | 原地脚弓向前贴地短传 | 2 |  |
| 原地侧方短传 | 6\_2 | 原地脚弓向侧方贴地短传 | 2 |  |
| 原地中距离传 | 6\_3 | 原地向前中距离传球 | 2 |  |
| 原地长传 | 6\_4 | 原地向前长距离传球 | 2 |  |
| 跑动向前直塞 | 6\_5 | 带球跑动过程中向前短传直塞 | 2 |  |
| 跑动短传中 | 6\_6 | 带球跑动过程中短传传中 | 2 |  |
| 跑动中距离传 | 6\_7 | 带球跑动过程中向前侧方中距离传球 | 2 |  |
| 跑动长传 | 6\_8 | 带球跑动过程中向前长传 | 2 |  |
| 停球 | 带球停球 | 7\_1 | 带球跑动过程中踩球停球 | 3 |  |
| 接低平球 | 7\_2 | 用脚弓接别人传的低平球停球 | 2 |  |
| 接空中球 | 7\_3 | 用脚弓接别人传的半高球停球 | 2 |  |
| 胸部停球 | 7\_4 | 胸部接别人传的半高球停球 | 2 |  |
| 射门 | 带球推射 | 8\_1 | 带球过程中用脚弓推射射门 | 2 |  |
| 带球抽射 | 8\_2 | 带球过程中用脚背抽射射门 | 2 |  |
| 挑射 | 8\_3 | 带球过程中用挑射射门 | 2 |  |
| 接球推射 | 8\_4 | 接传球用脚弓推射射门 | 2 |  |
| 接球抽射 | 8\_5 | 接传球用脚背抽射射门 | 2 |  |

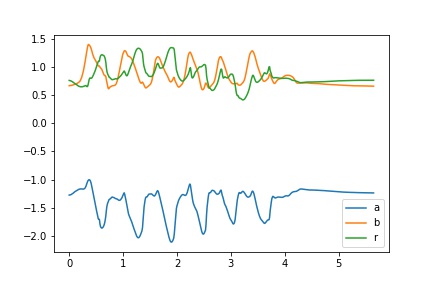
* 各动作中欧拉角变化特征



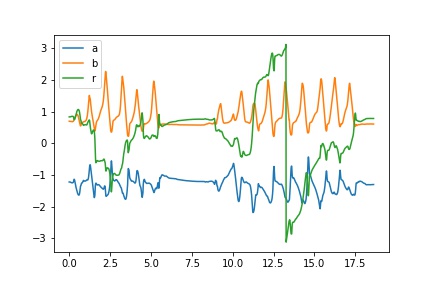
11向前走



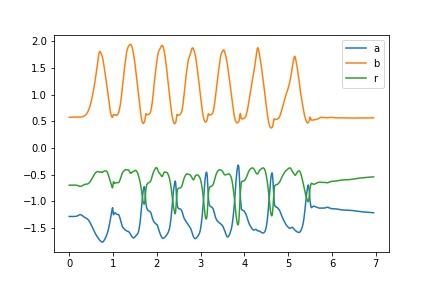
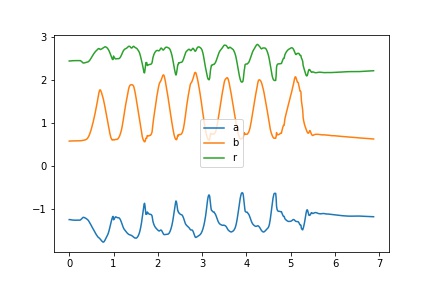
12向后走



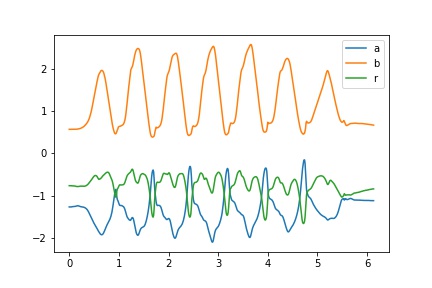
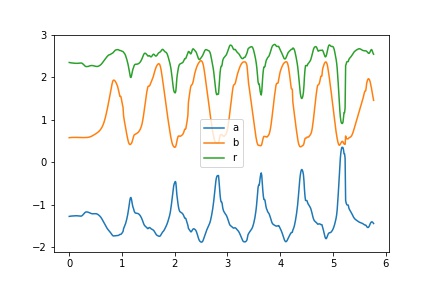
13侧面移动：向左右两侧水平移动，6步以上



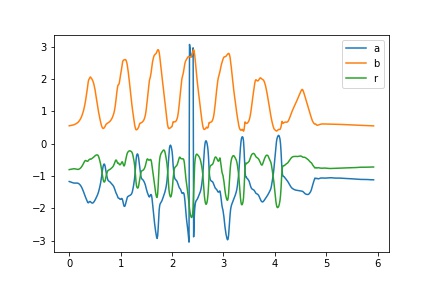
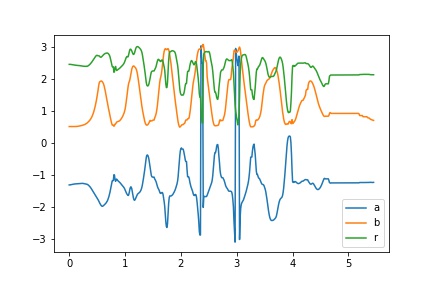
14走动组合：向任意方向随意走动



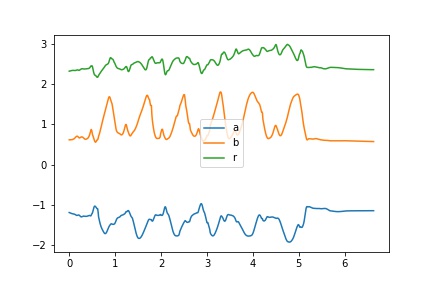
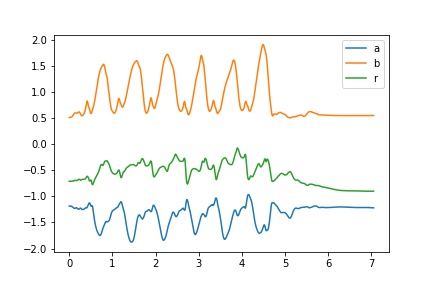
21向前小跑



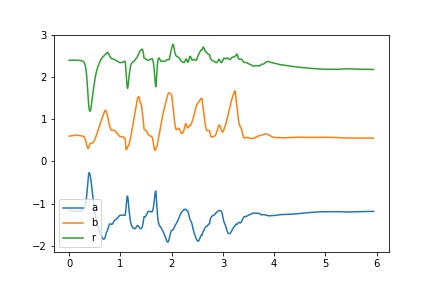
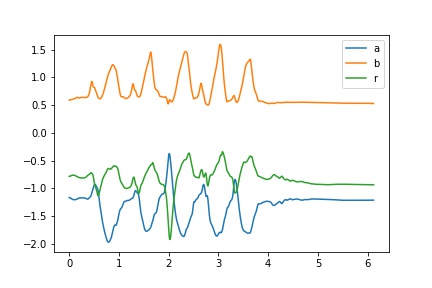
22向前中速跑



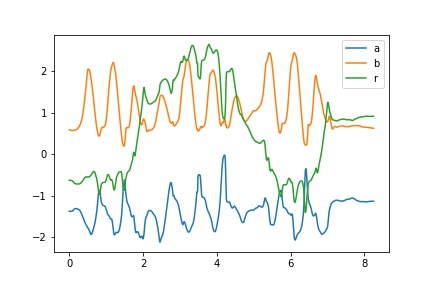
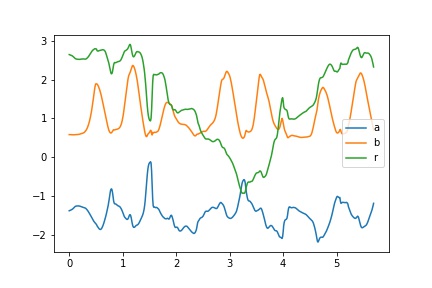
23向前冲刺



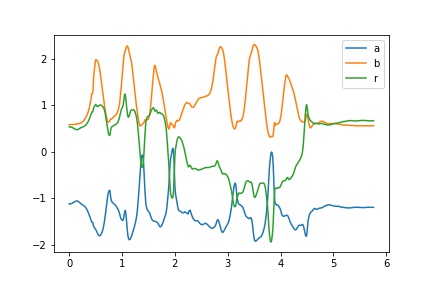
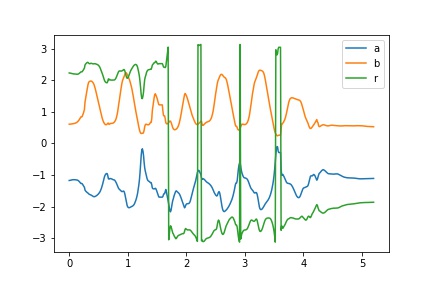
24向后小跑



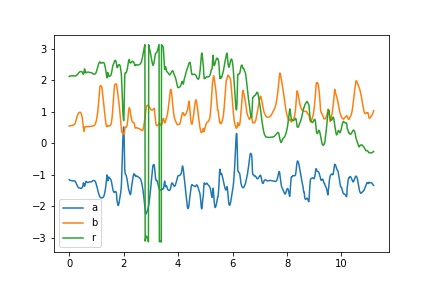
25后撤步跑



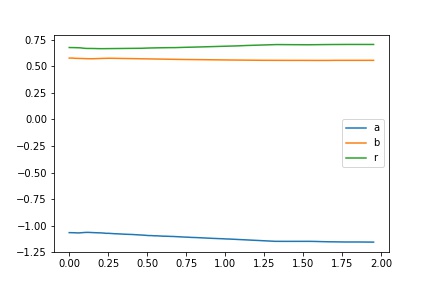
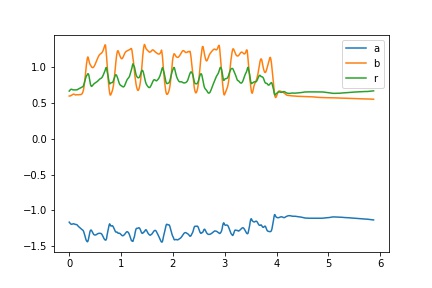
26折返跑



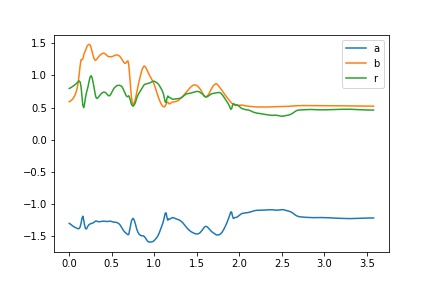
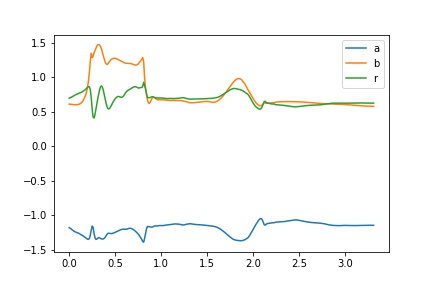
27转身跑



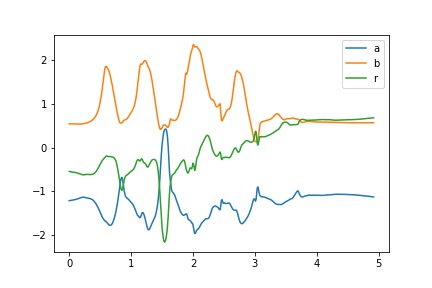
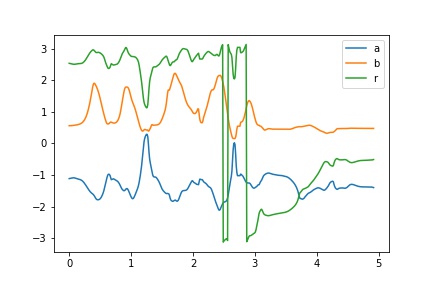
28跑动组合



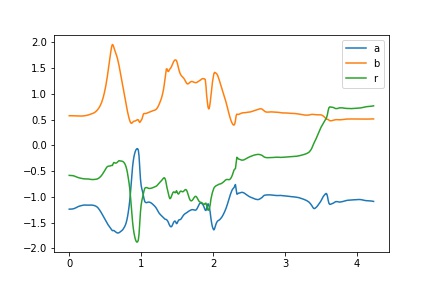
31原地小跳



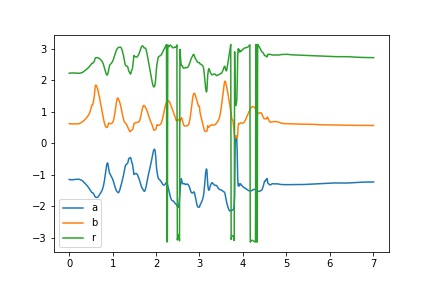
32原地起跳



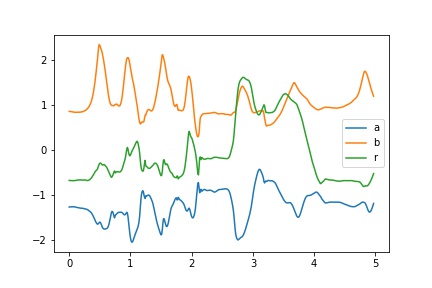
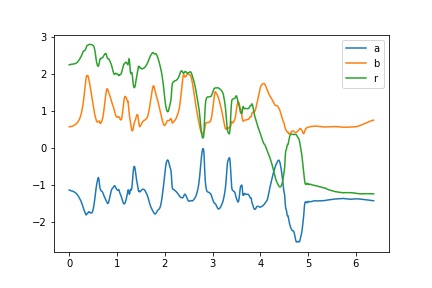
33原地前跳



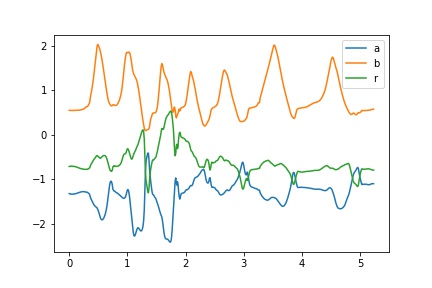
34跑动前跳



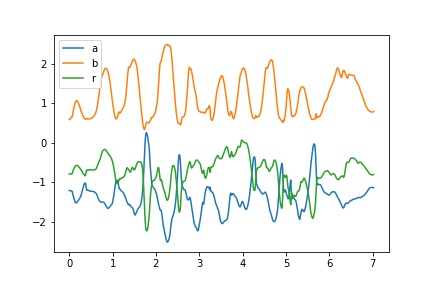
41抢位



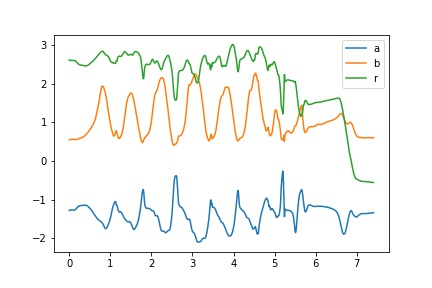
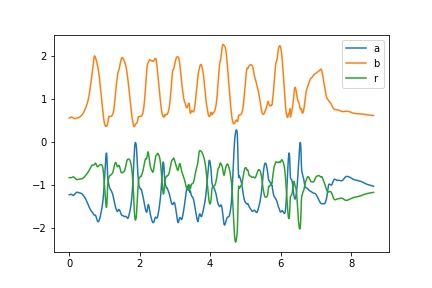
42抢断



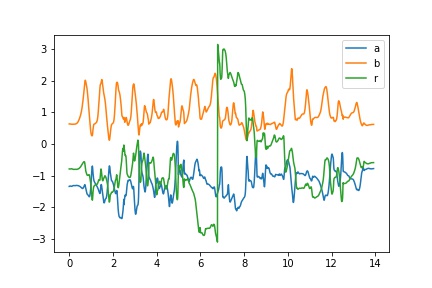
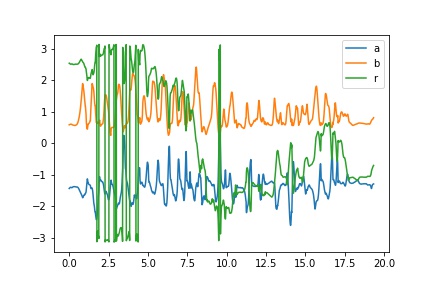
43拦截



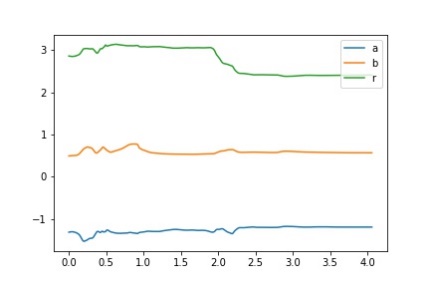
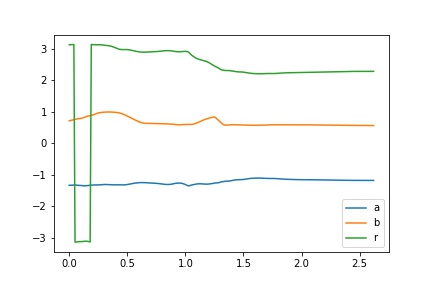
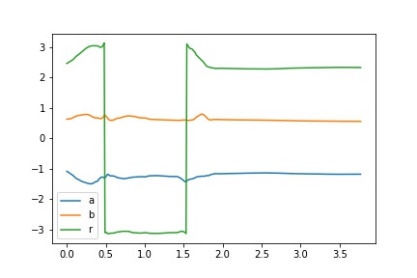
51脚弓向前带球



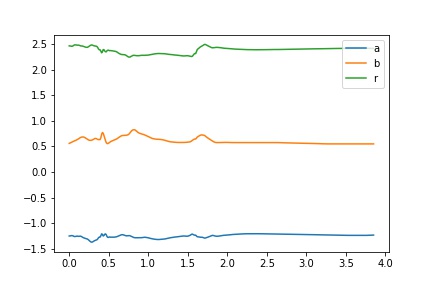
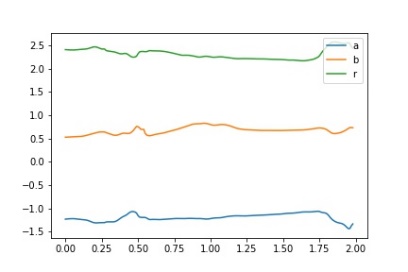
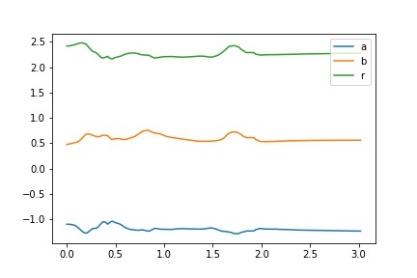
52脚背向前带球



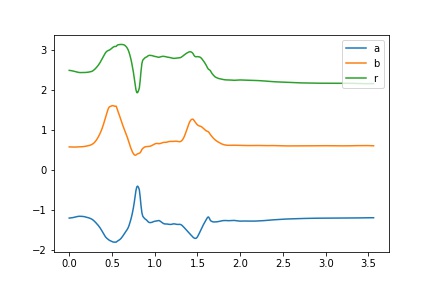
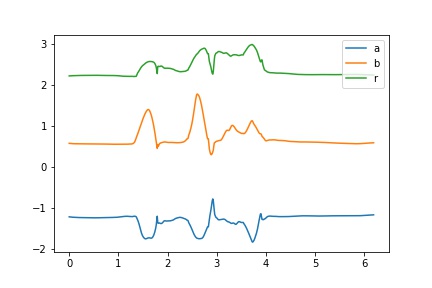
53变相带球



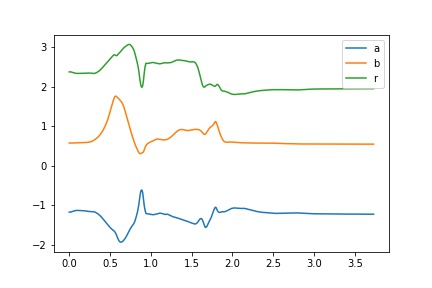
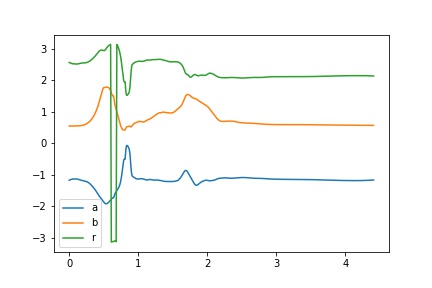
61原地向前短传



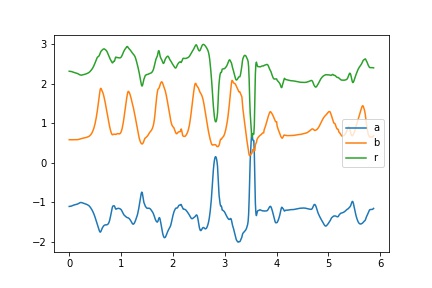
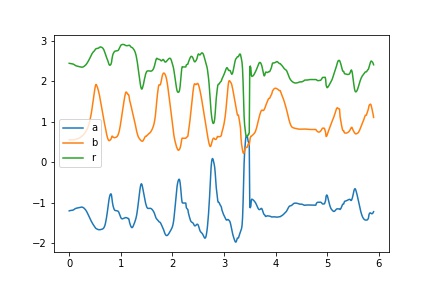
62原地侧方短传



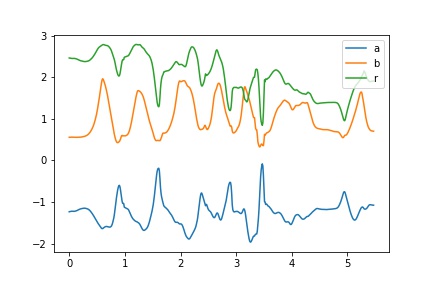
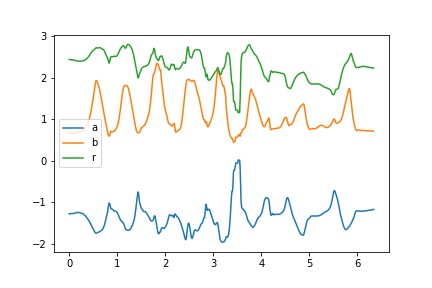
63原地中距离传



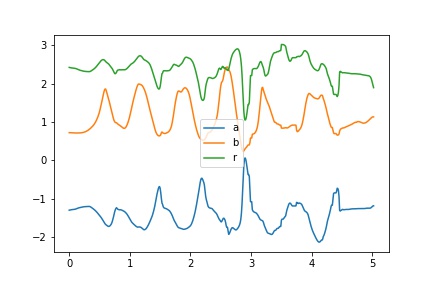
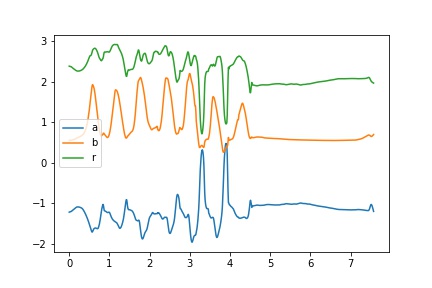
64原地长传



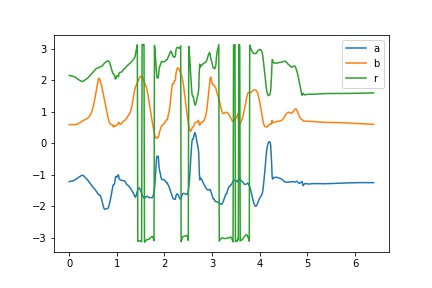
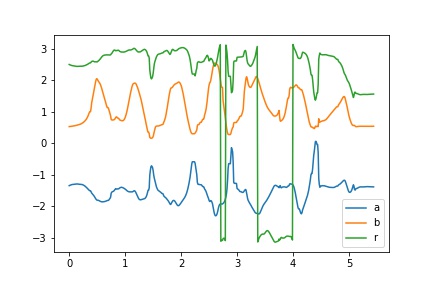
65跑动向前直塞



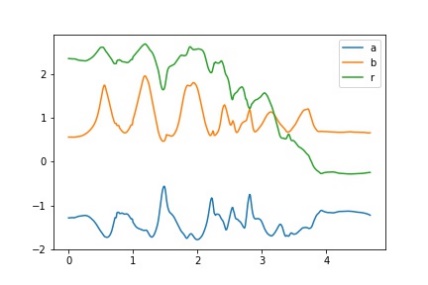
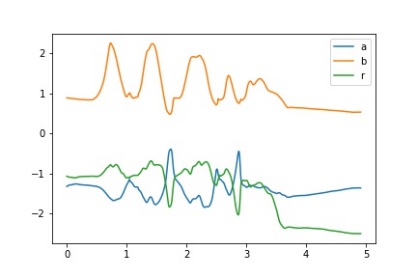
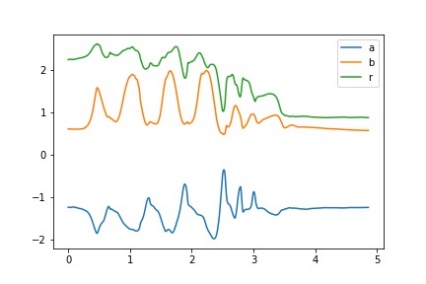
66跑动短传中



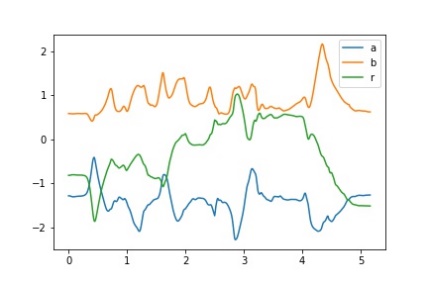
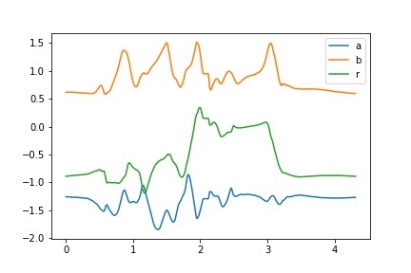
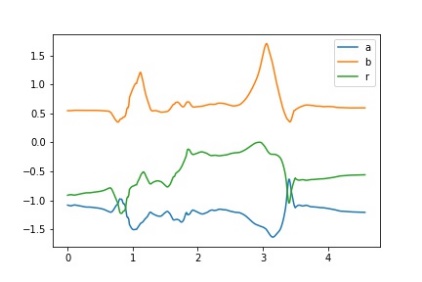
67跑动中距离传



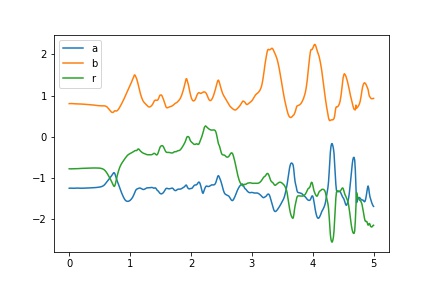
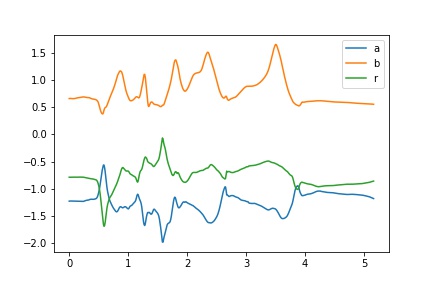
68跑动长传

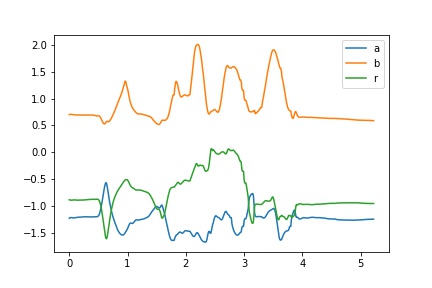
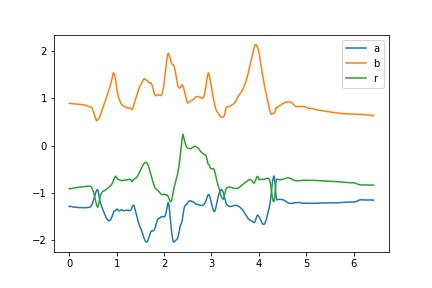


71带球停球

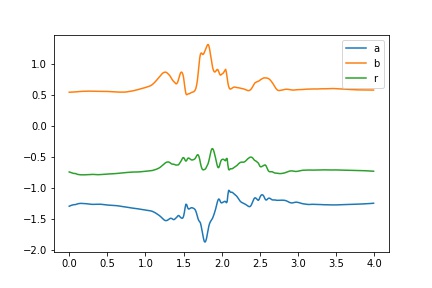
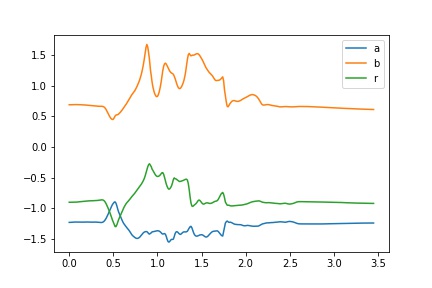


72接低平球

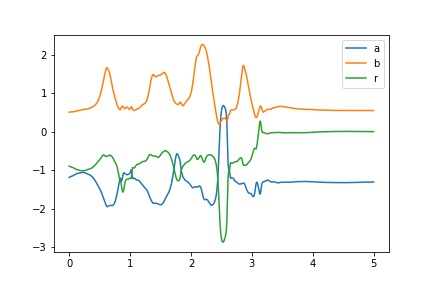
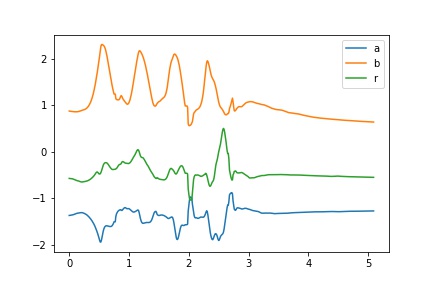




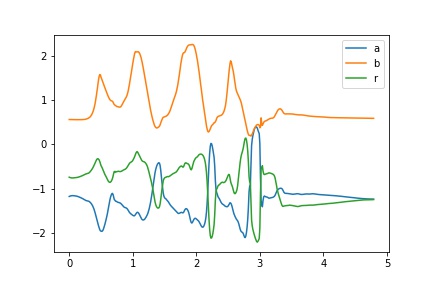
73接空中球



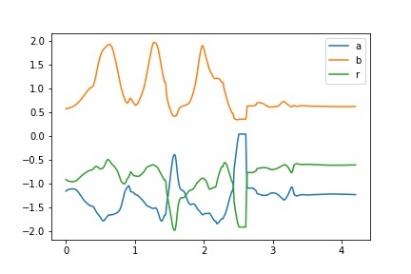
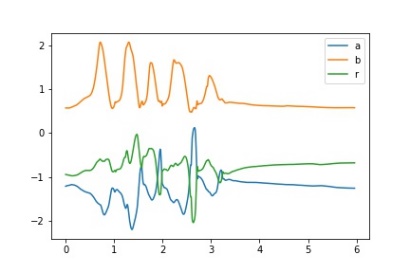
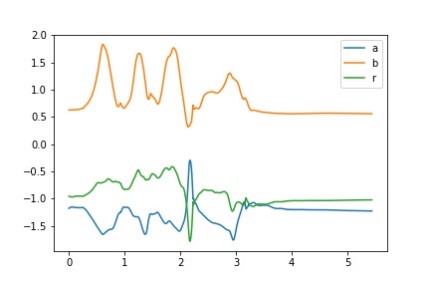
74胸部停球



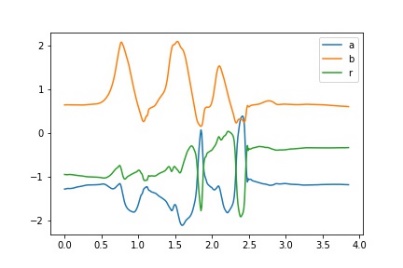
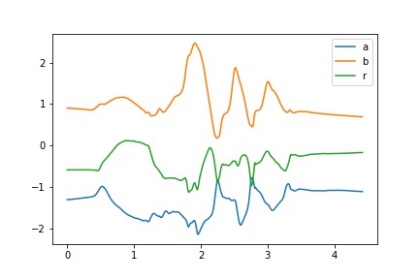
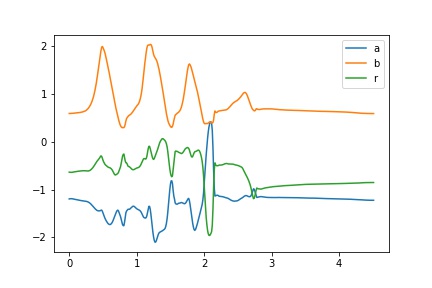
81带球推射



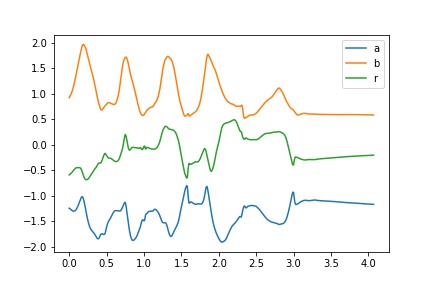
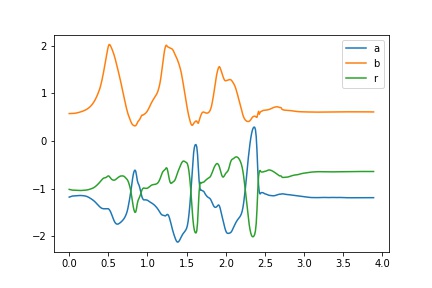
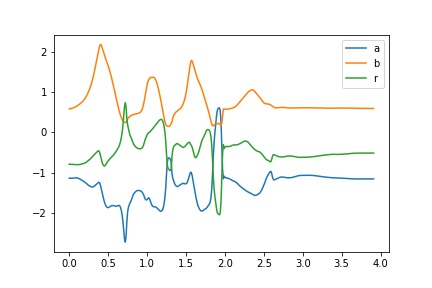
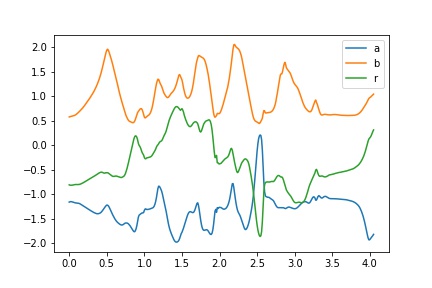
82带球抽射



83挑射



84接球推射



85接球抽射