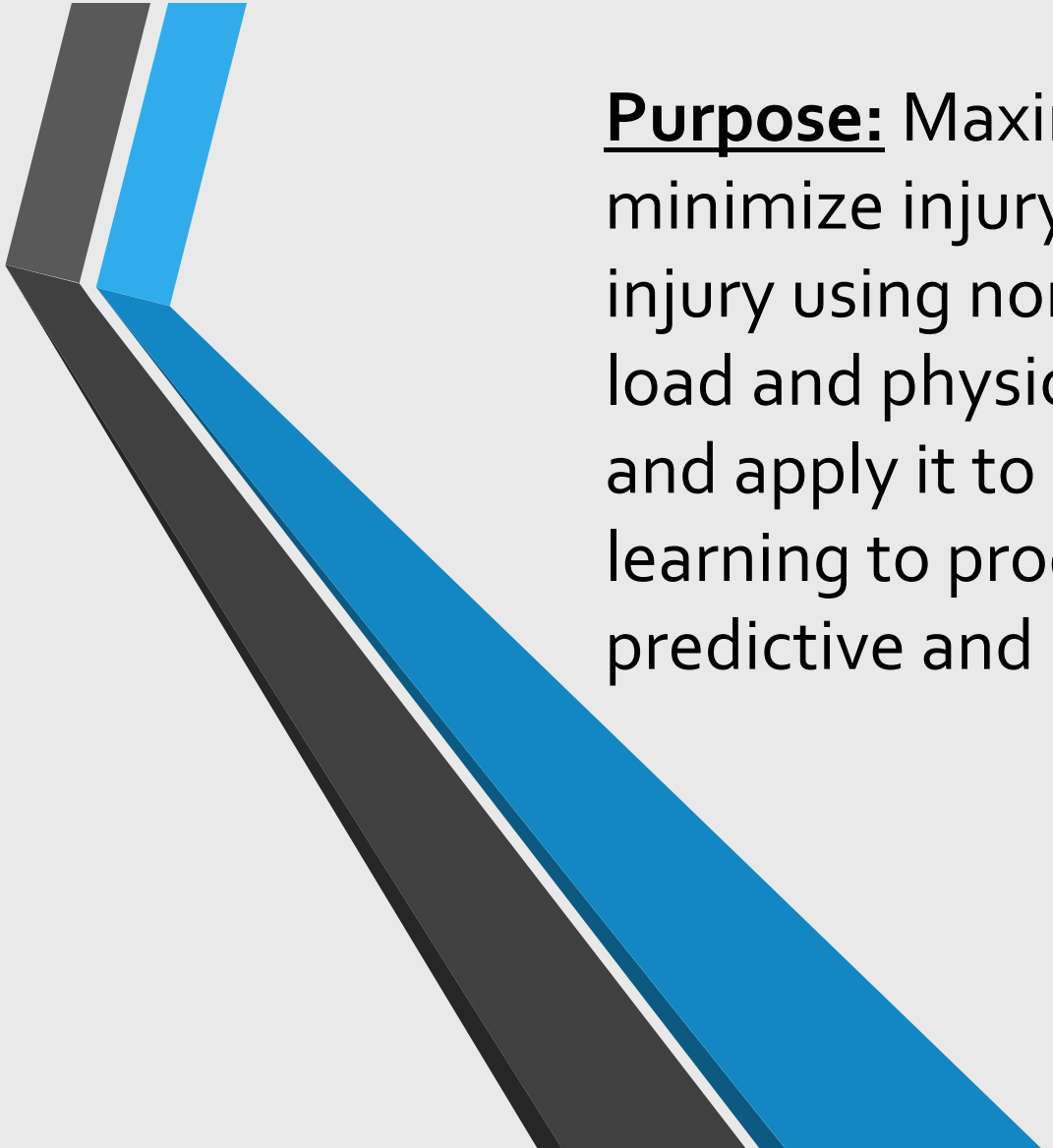
Big Data and Deep Learning for Monitoring Athletes:

Fatigue vs. Readiness Balance



Purpose: Maximize performance, optimize training, minimize injury and guide athletes in return to play from injury using noninvasive technology to monitor training load and physiological responses (relative fatigue index) and apply it to advanced integrative analytics and deep learning to produce automated and personalized predictive and prescriptive feedback

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Who we are

- Master's students in Sport Physiology who will become Strength and Conditioning Professionals for elite athletes
- KINE 689 Technology and Data Analytics for Sport Performance
  - Chaz Bracci
  - Matt Bird
  - Josh Demsey
  - CJ Mikkelsen
  - Nicos Georghiades
- Startup company

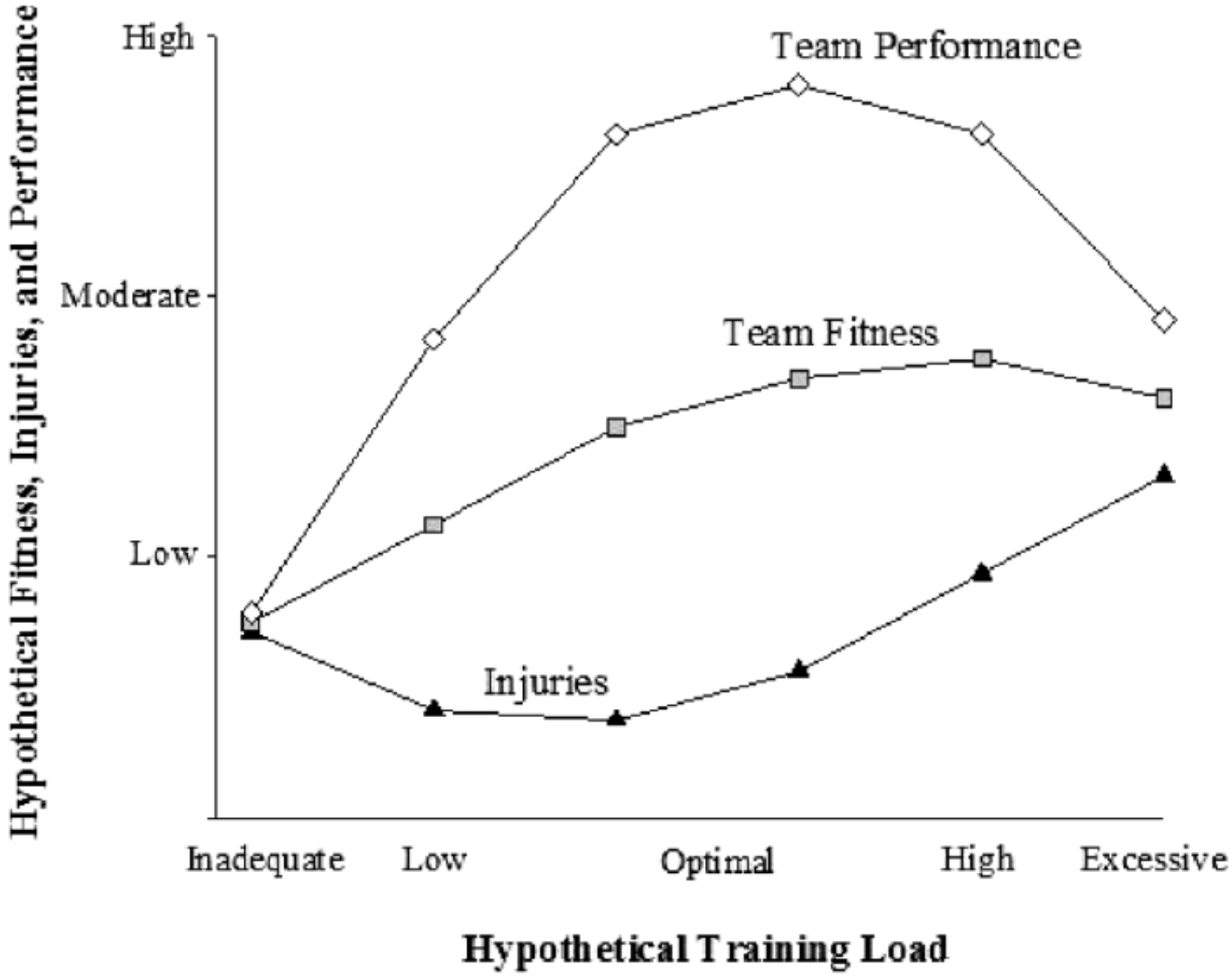
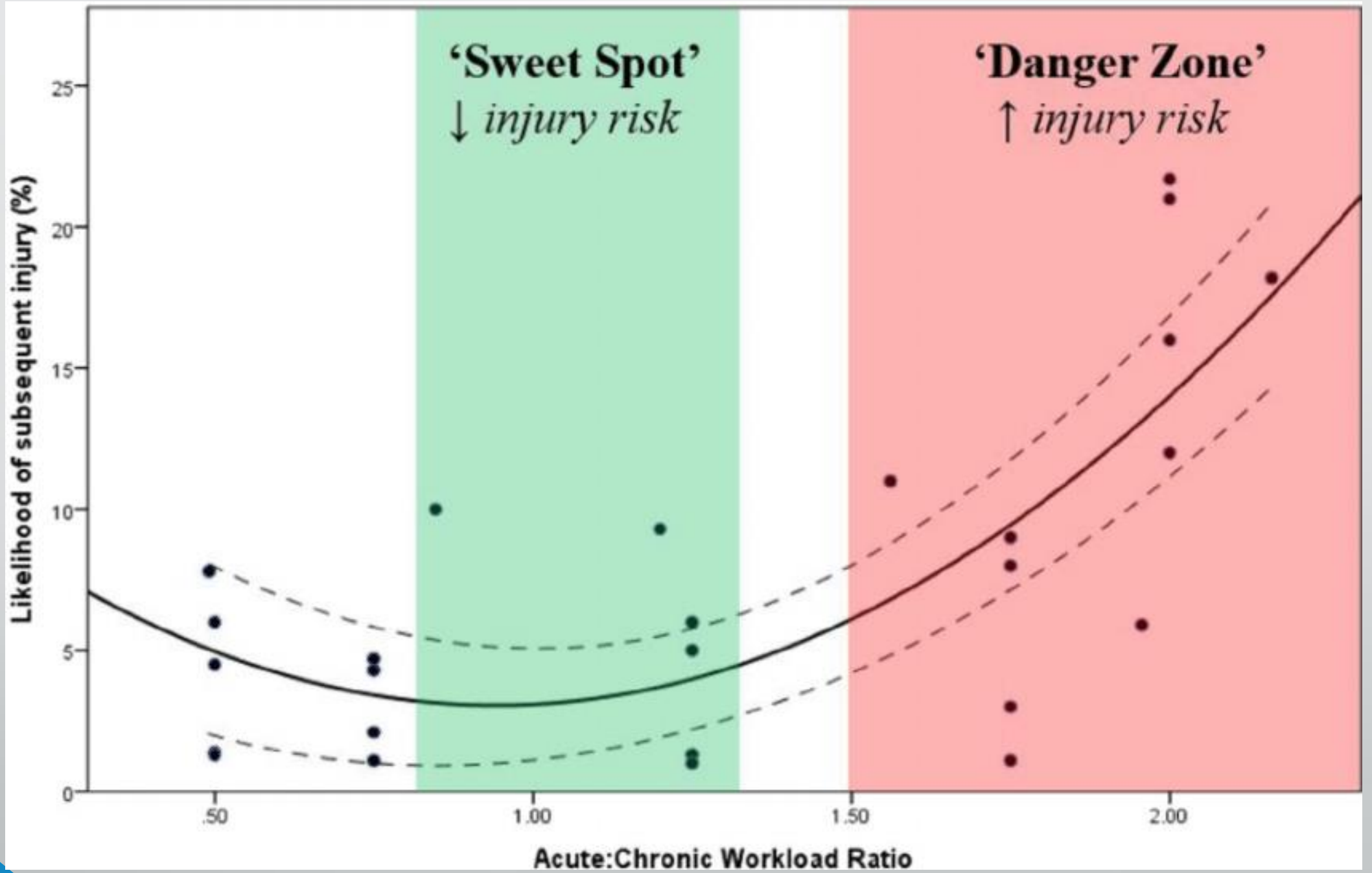


Figure 1 Hypothetical relationship between training loads, fitness, injuries and performance. Redrawn from Orchard.[1]

2012, Gabbett TJ, 2015


'Sweet Spot'
↓ injury risk
'Danger Zone'
↑ injury risk
Likelihood of subsequent injury (%)
0
5
10
15
20
25
.50
1.00
1.50
2.00
Acute:Chronic Workload Ratio

Challenges

- Managing billions of data points
- Integrate a complex set variables
- Learn individuals unique responses
- Provide real time feedback on deviations from normal responses in an actionable format
- Provide new insight into athlete status to optimize training and maximize performance

Managing billions of data points

- Synchronize time sequence of multiple measurements
- Real-time upload to a cloud/server (wifi, Bluetooth, cell)
- Database organization (data recognition algorithm)

Integrate a complex set variables

- Analytical methods that can contextualize an individual variable with other data inputs

  e.g. elevated heart rate without motion indicates psychological stress

  e.g. motion without elevated heart rate indicates no work

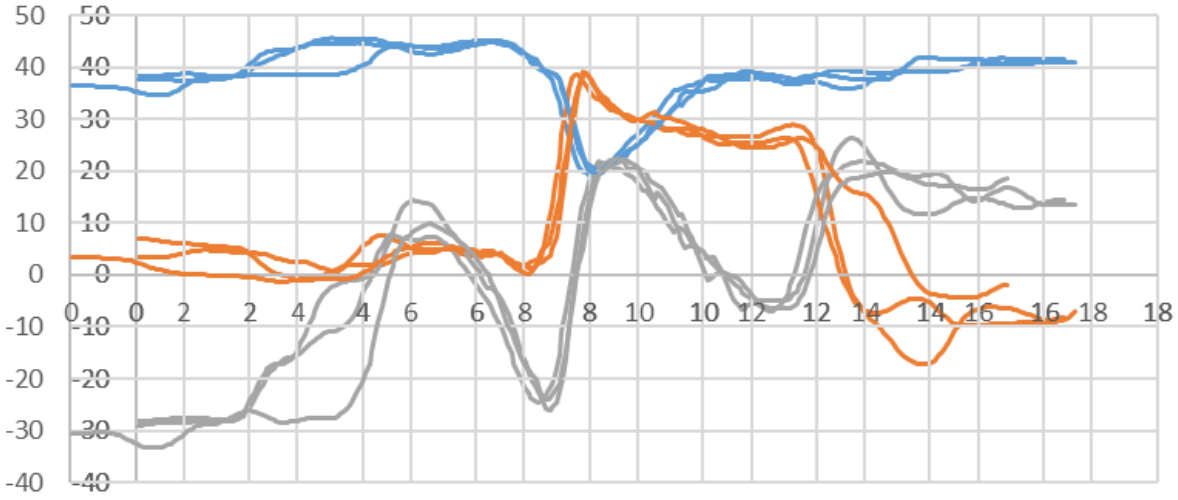
- Use multiple variables to draw conclusions

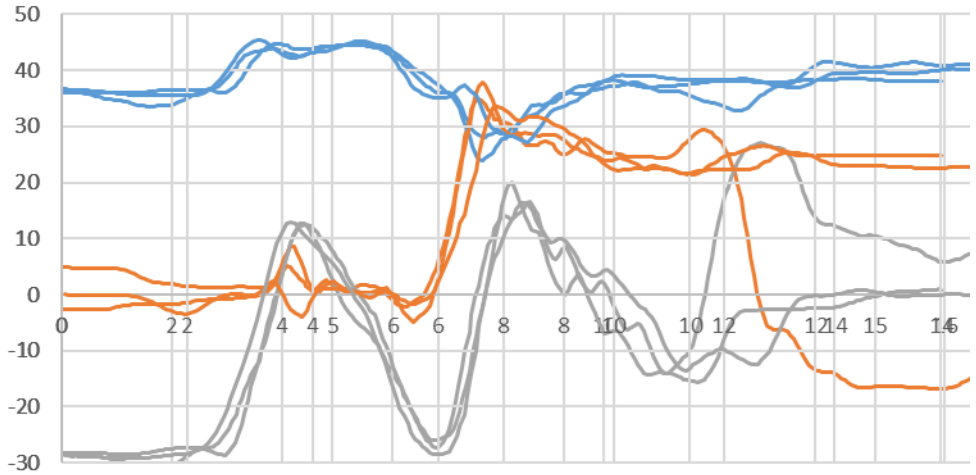
  e.g. HRV in rest, sleep, activity, exercise and stress

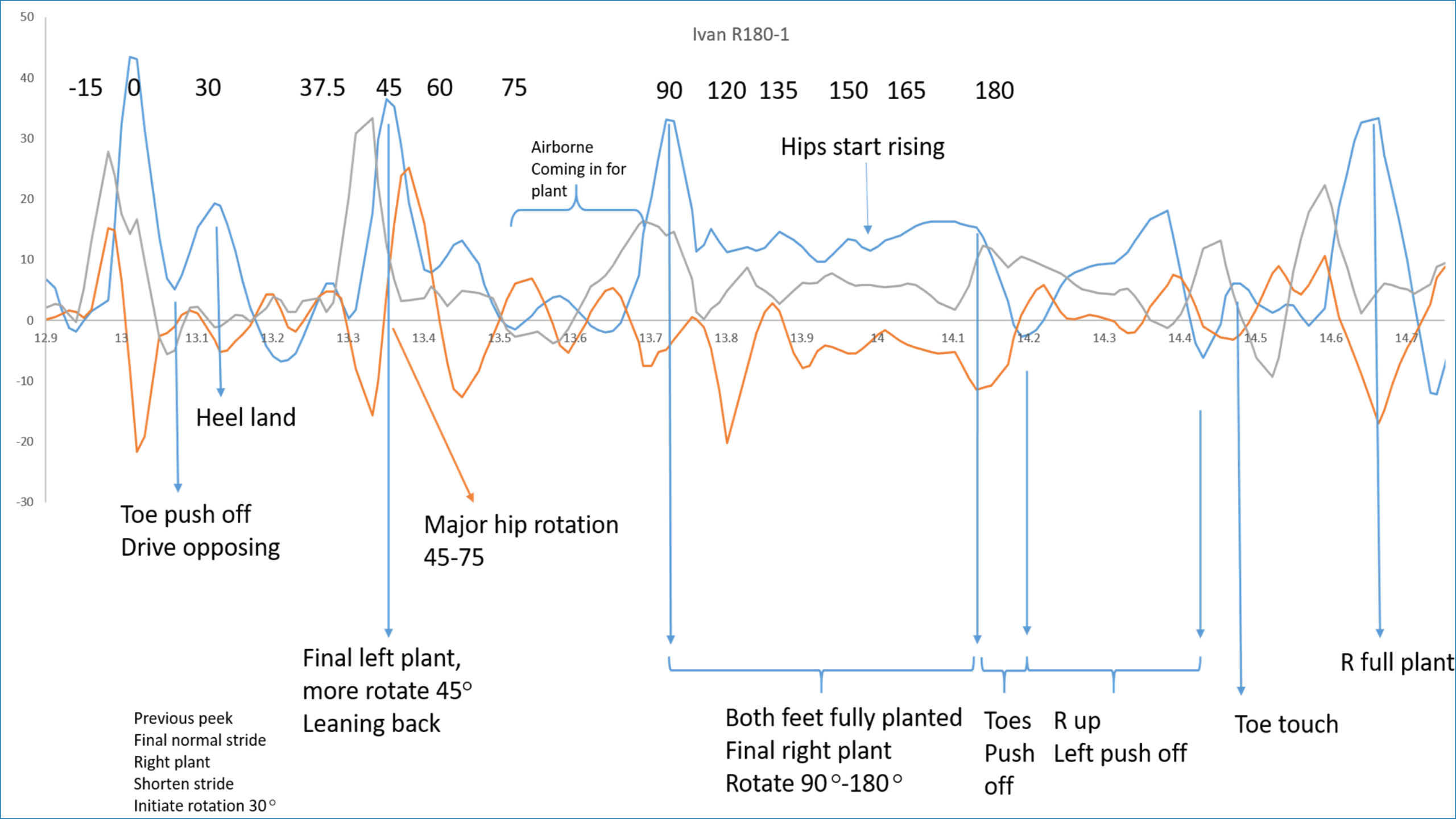
Learn individuals unique responses

- Common features of complex data can be identified but individual variability can limit its usefulness
- Develop a two tiered learning algorithm that learns general patterns from population data and through extensive inputs from the individual, identifies unique patterns
- Challenge is extended to distinguish personalized variations that are normal (no negative consequences) and those that should be corrected
- Learning should adapt and detect progression (increased fitness) and regression (fatigue, return from injury)

Movement analyses are highly reproducible and similar between individuals






Ivan R180-1
-15
0
30
37.5
45
60
75
90
120
135
150
165
180
Airborne
Coming in for
plant
Hips start rising
Heel land
Toe push off
Drive opposing
Major hip rotation
45-75
Final left plant,
more rotate 45°
Leaning back
Previous peek
Final normal stride
Right plant
Shorten stride
Initiate rotation 30°
Both feet fully planted
Final right plant
Rotate 90°-180°
Toes
Push
off
R up
Left push off
Toe touch
R full plant

Provides real time feedback on deviations from normal responses in an actionable format

- Immediate upload, reference analysis, deviation detection and feedback
- Actionable format can take several forms including but not limited to reminder (fyi), warning, danger (stop exercising), specific action (drink water)
- Return to play analyses could include % of preinjury performance
- Feedback include adjustments in training load to maintain optimal

Provide new insight into athlete status to optimize training and maximize performance

- Deep Learning needs continually update associations and report potential new insights in the data monitored
- Incorporate new data as technology evolves and new devices become available.

Going Forward

- Partners for technology development
- Partners for Data Analytics
- Development and Validation of technology and deep learning analytics
- Venues for technology deployment
- Venues for application of new approaches to data analytics for sport performance

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