



# *Analyst, Sports Science Hiring Project*

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## ***Force Plate Data translations & next steps***

### **Focus: Return from Injury Pillar**

- In the paper provided by the Twins, as well as some prior use cases and independent research both '*Return from Injury*' & '*Neuromuscular Fatigue*' seemed to be areas of analysis that provide the biggest benefit from using force plate data.
- ***Next steps with more time:***
  - I would devise a daily application with both a 'Return From Injury' testing module & a 'Neuromuscular Fatigue' module. Athletes & their coaches, especially those getting used to new stimuli (return from injury, spring training, increase in recent workload etc.) would use the tool daily to gauge how their neurobiological system is faring against their usual baselines. Players & coaches in baseball often utilize a test-retest model with recovery, hybrid & maximum output days. The goal of the tool would be to highlight player fatigue to change hybrid/maximum output days to recovery days in the hope of mitigating subpar performance due to fatigue as well as potential injury.
- ***Additional data (to work in):***
  - WHOOP strap or Oura ring data to cross reference variables such as strain score, heart rate variance, recovery & sleep scores against our CMJ data to better understand causes of individual player fatigue as well as performance habits we can improve to potentially create marginal gains in deficient areas.





## *How data can be used to track against Return from Injury Metrics*

- In isolating the metrics in Figure 1 & those from the provided research paper that have been proven as historical, peer-reviewed accepted evidence around causation: deceleration, landing, and interlimb asymmetry are all major factors in differentiating between athletes with & without injuries.
- **Peak Propulsive Force (Newtons)**
  - Peak Vertical ground reaction force applied to the system center of mass during the propulsion phase. During the recovery phase, athletes often experience muscle atrophy and neuromuscular imbalances due to immobilization and reduced activity. Monitoring peak propulsive force assists in evaluating the effectiveness of rehabilitation protocols in restoring player ability.
- **Peak Landing Force (Newtons)**
  - Peak Vertical ground reaction force is applied to the system center of mass during the landing phase. It will help determine whether an athlete's lower body can handle the forces associated with sports-specific movements, such as jumping, cutting, and pivoting. As well as unplanned sudden input, like a hard late slide into the outside of a base.

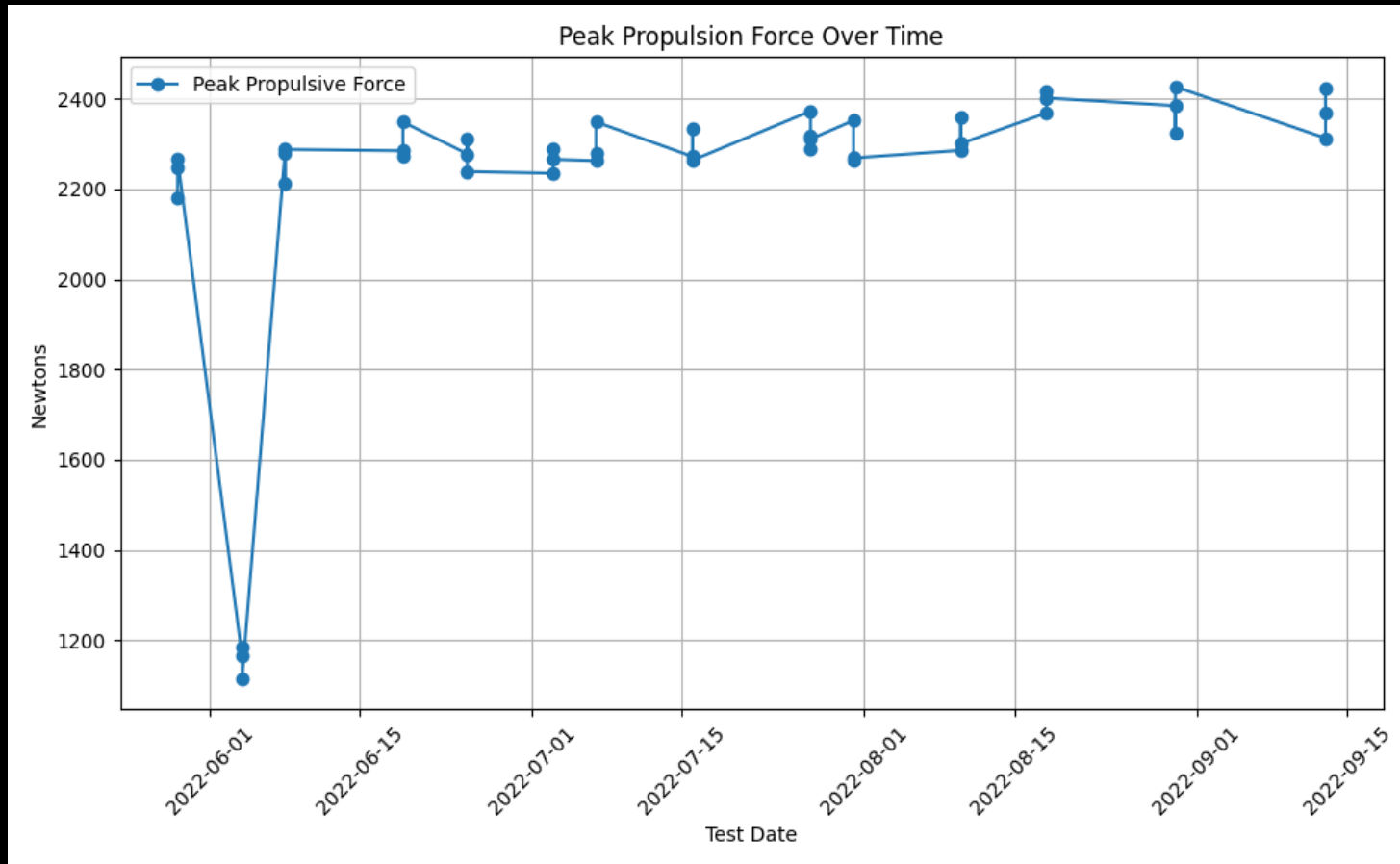


## *How data can be used to track against Return from Injury Metrics*

- **Landing Impulse (Force over Time)**
  - In injury specifics, default is systematically referred to 'normalization of a stressor over time' and therefore the 'Landing Impulse' visual is designed to show peak forces over time and the time to stabilize them as a cue in the athlete's rehabilitation. As the athlete returns, they will gradually be exposed to environments where they create more & more force. More time to stabilize the same force could indicate an issue with tolerance or breakdown in the system.
- **Asymmetry (Percent)**
  - Athletes who demonstrate greater than 15% eccentric asymmetry have been linked to higher risk of lower body injury. An author of the provided article: Matt Jordan, has shown further research where athletes with relatively clean lower body injury history showed no significant asymmetry patterns over time, while those with ACL injury history exhibited a pattern in their asymmetries, along with a higher degree of asymmetry. The presence of any pattern of asymmetry within one athlete's trials was well correlated with injury history



## Sample Data: Peak Propulsive Force

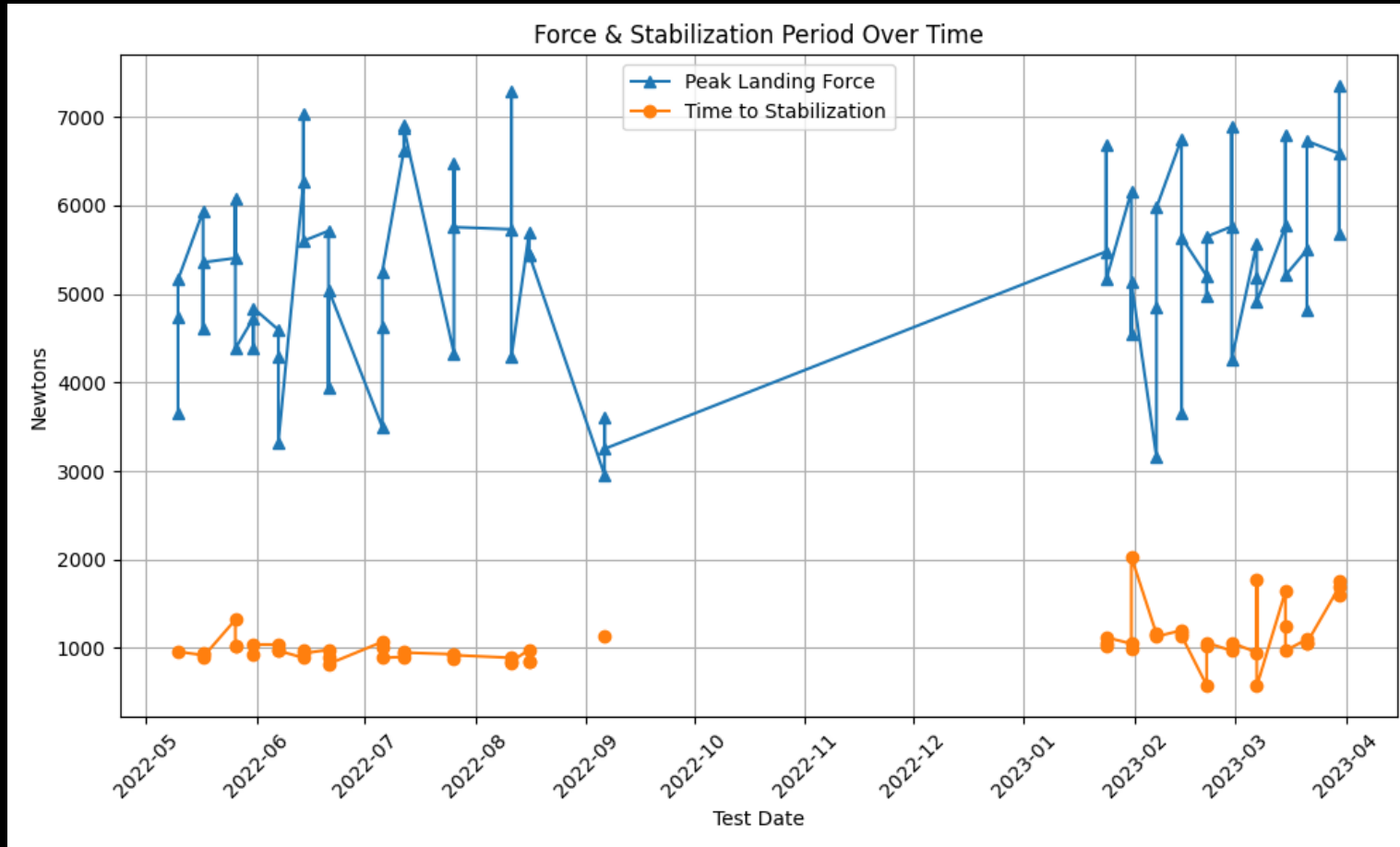


*Random player data selected from sample data provided:*

Player ID #46 showed a lack of peak propulsion force in the first week of June during their evaluation as compared to their baseline assessment. Data validity is ensured as through three trials the same issue persists. As a result, the athlete's training methodology for the day should be pivoted towards low force recovery activities if not already outlined (or they should be given the day off).



## Sample Data: Peak Landing Force & Landing Impulse



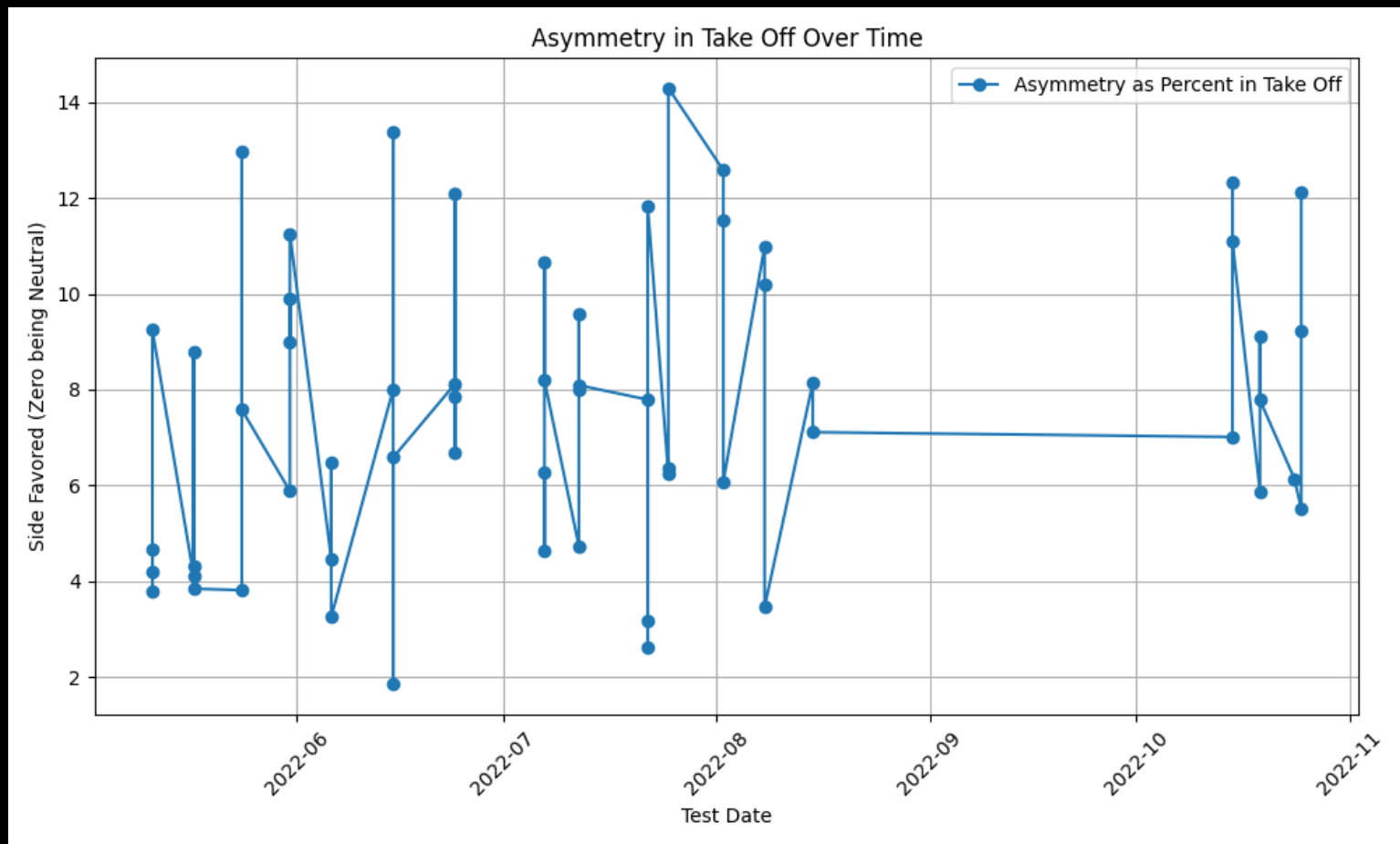
*Random player data selected from sample data provided:*

Player ID #34 showed a lack of peak landing force in their last evaluation of 2022. As the season is at the end, this can most likely be attributed to fatigue as we see a sharp return to normalcy upon their next test in 2023 after a brief break.

I included **Time to Stabilization** as an "Impulse" reference for force over time. Peak force is accepted by the system during the stabilization phase. If we see that is taking longer to acclimate to the same landing force that could indicate the biological system working harder for the same usual task & could warrant rest.



## Sample Data: Asymmetry

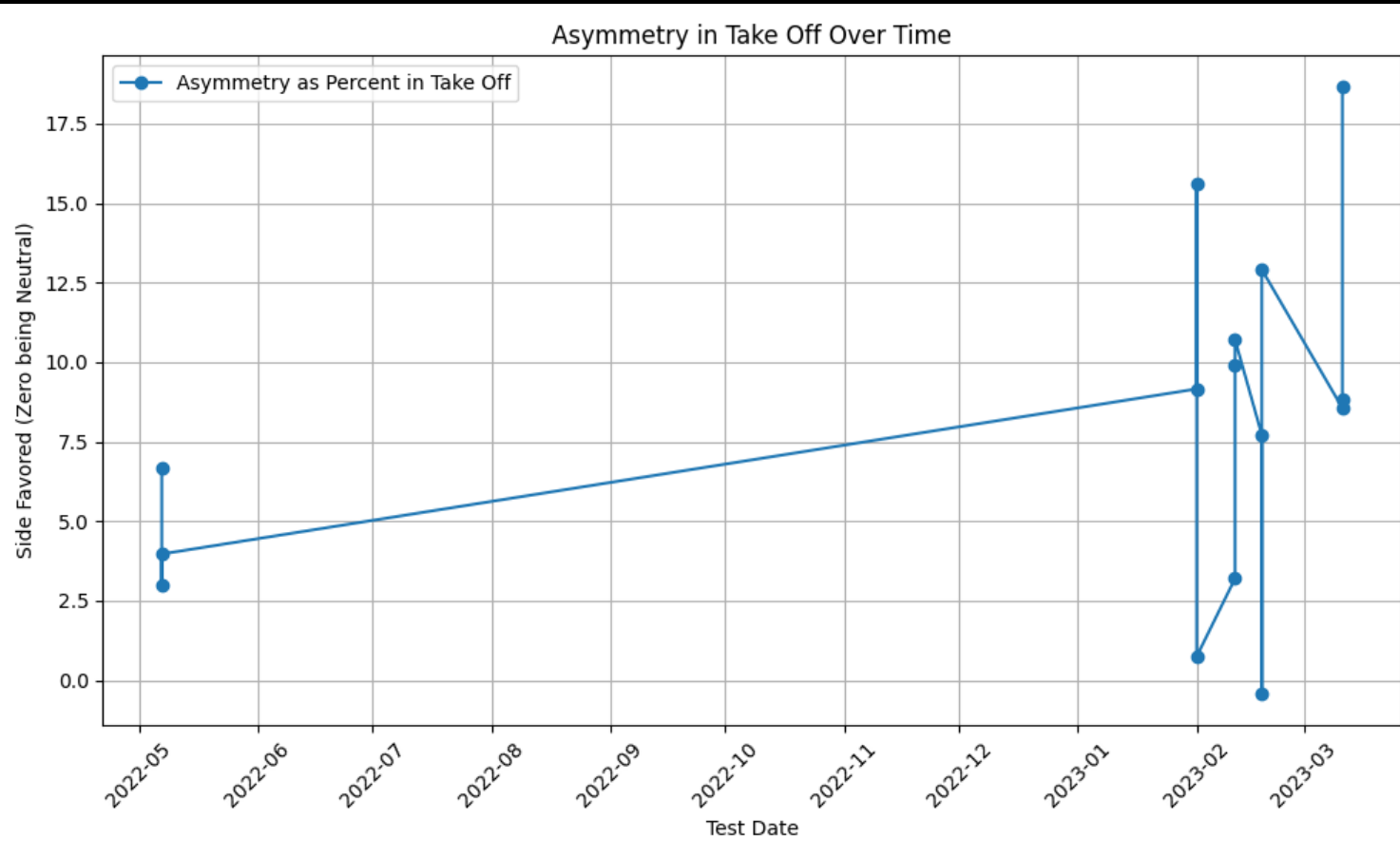


*Random player data selected from sample data provided:*

Player ID #228 showed a healthy takeoff when first being evaluated with a value of around 4%. Profiling him into a normal threshold. Our provided paper's author: Matt Jordan has shown high correlation with lower limb asymmetry over 15%, at no point does our athlete fall outside of that range though they definitely show signs of depreciation as the season goes on. All normal when accounting for fatigue and the usual toll a season takes on biological systems.



## Sample Data: Asymmetry (when abnormal)



*Player data selected by sorting for players who initially profiled as 'healthy' but had a percent asymmetry over 15% at multiple points.*

Player ID #237 showed a healthy takeoff when first being evaluated with a value averaging around 4%. Upon retest several months later, the asymmetry rises to 15% before fluctuating between 1 & 18%. The absence of testing between 06/2022 and 02/2023 suggests an injury, the fluctuations of asymmetry afterward suggest the subject is going through their rehab phase & is continually working to establish a new baseline.





## Dynamic Program changes according to Pre Training Testing: Control Flow

