Quantifying Defensive Spin Moves in American Football: A Player Tracking Analysis

Samuel Jin

Gunn High School, Palo Alto, CA

Email: samueljin99@gmail.com

Background

Although previous public research has been done on football linemen in general, there has been limited exploration of individual moves and techniques. This study develops a framework that identifies and evaluates spin moves, one prominent pass rushing move.

Building off this framework, we then evaluate defensive linemen on their ability to execute a spin move in a quantitative manner and analyze the factors that affect the efficacy of a spin move.

Methods

Part 1: Spin Move Detection Framework

- Calculate .8 second rolling sum of each defender's orientation on each unique play
- Filter dataset to plays where a defender's orientation rolling sum exceeded a threshold

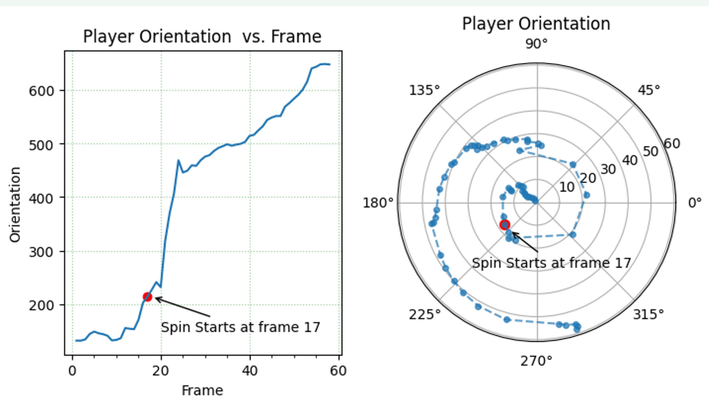
Part 2: Player Analysis Model

- Built XGBoost binary model to predict expected pressures on spin moves
- Calculate pressures over expected to quantify execution of spin moves

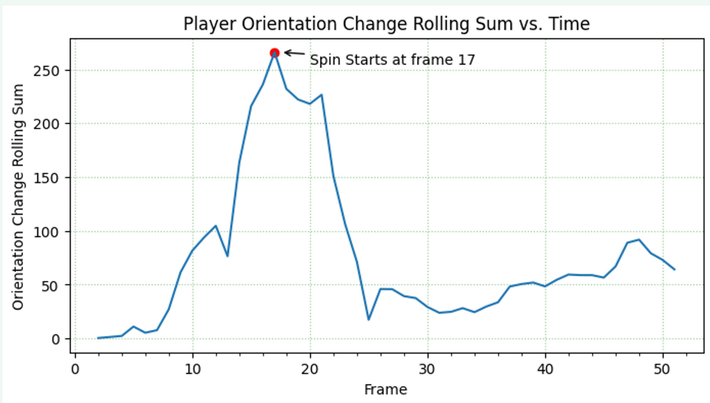
Data

- Player tracking data from 2023 NFL Big Data Bowl (Thanks NFL!)
- Weeks 1-8 of 2021 NFL Season
- Tracking Data:
  - Positional (x,y)
  - Speed
  - Orientation & Moving Direction
  - Acceleration
- Data gathered at 10 frames/sec (10 Hz)

Part 1: Spin Move Detection Framework



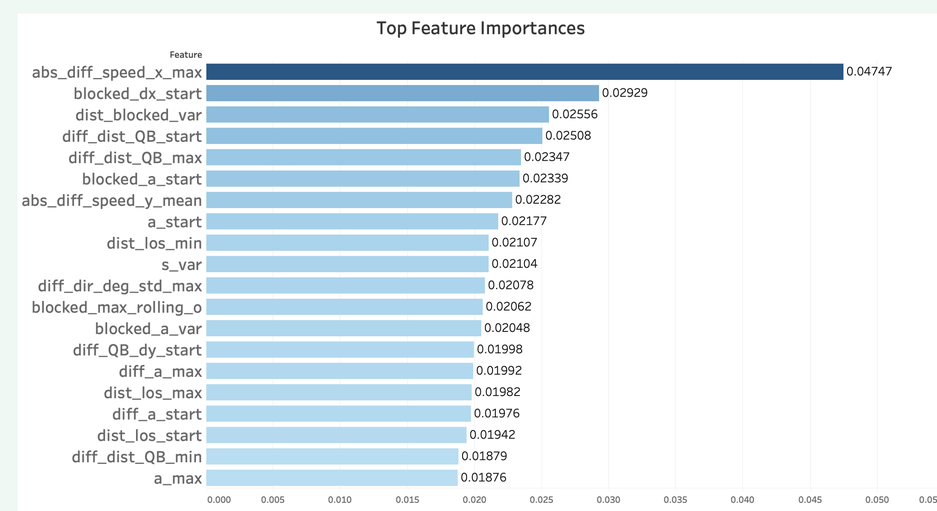
- Orientation tracking data can be affected by factors such as jostling at the line of scrimmage
  - Therefore, it is not enough to look at raw orientation
- To address this, we calculate a **rolling sum** of the change in a defender's orientation over each sequence of 8 frames
  - Ensures player is rotating in same direction, over a sustained period of time
  - Extraneous data effects are mitigated



- For each play, we record each pass rusher's highest orientation change rolling sum
- If |rolling sum| >= 200 degrees, we label the play-player instance as a spin move

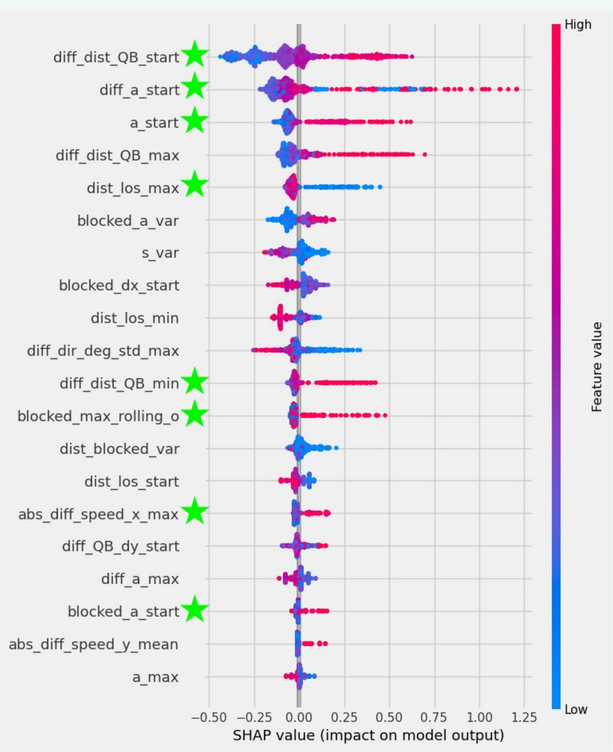
Part 2: Player Analysis Model

- Target: Pressure (1) or No Pressure (0)
- XGBClassifier looks at **1 second before spin move starts**
- Features such as difference in speed, displacement, difference in distance to QB, acceleration, speed, etc.
  - Computed properties like maximum, variance, mean
- Model outputs an expected probability of pressure, used to create an over-expected metric
- 86% accuracy on 70/30 Train-test split



Model Evaluation: Findings

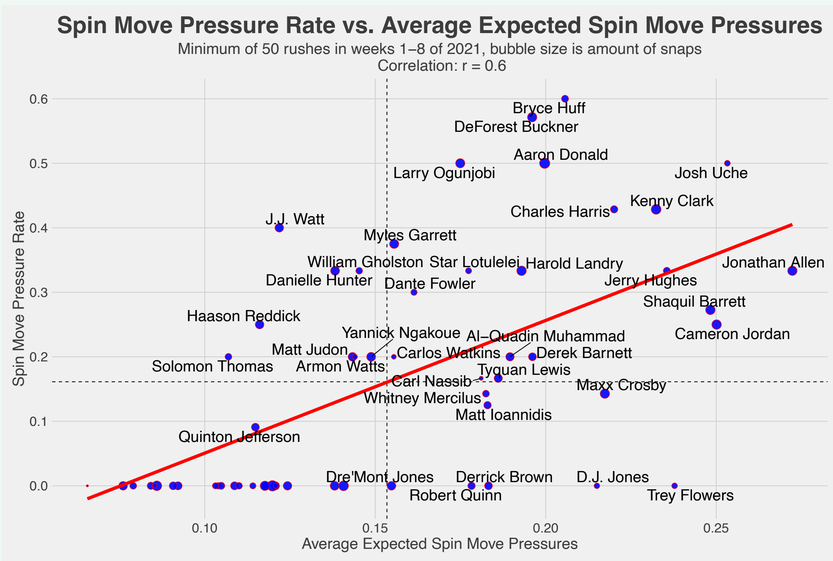
- **SHAP Values: Model Interpretation**
  - SHAP (Values) allow us to get a more granular, detailed look at the "black box" model
  - Examine the magnitude and direction of individual feature effects
- **Spin Move Pressure Over-expected Metric**: Residual of Pressure – Expected Pressure
  - Evaluate how good the rusher is at executing the spin itself



Spin Move Pressure Over Expected Leaders

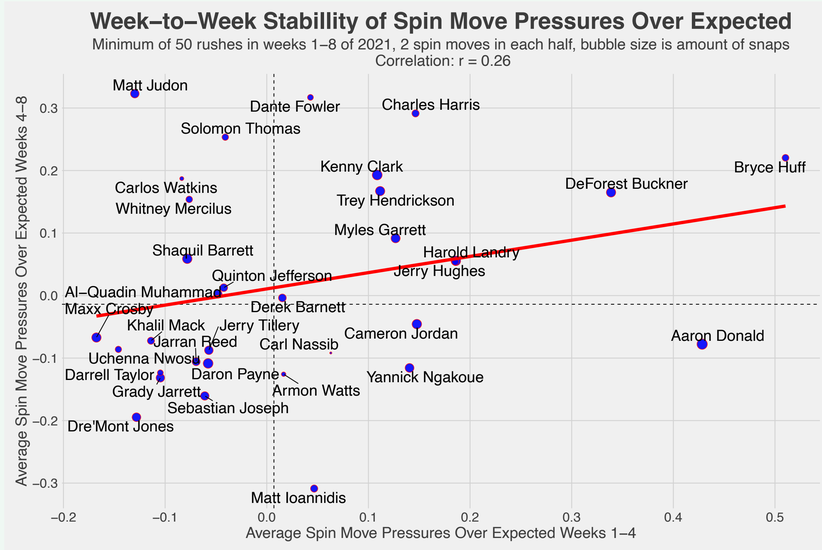
Weeks 1-8 of 2021

RANK	NAME	TEAM	SPIN MOVES	AVG. SPIN PRESSURES OVER EXPECTED
1	Bryce Huff	NYJ	5	0.394
2	DeForest Buckner	IND	10	0.304
3	Haason Reddick	CAR	5	0.284
4	Larry Ogunjobi	CIN	7	0.254
5	Charles Harris	DET	7	0.209
6	Danielle Hunter	MIN	6	0.195
7	William Gholston	TB	6	0.188
8	Aaron Donald	LA	8	0.175
9	Kenny Clark	GB	10	0.168
10	J.J. Watt	ARI	7	0.164
11	Josh Uche	NE	5	0.147
12	Solomon Thomas	LV	8	0.143
13	Trey Hendrickson	CIN	8	0.132
14	Myles Garrett	CLE	11	0.117
15	Jerry Hughes	BUF	6	0.098



- Moderately Strong correlation
- r = .6
- Model lines up well with traditional metrics
- Supports over-expected metric

- Moderate Correlation
- r = .26
- Relatively stable over the course of a season
- Shows that metric has some signal
- Limited sample size
- Prone to some outliers



Discussion and Future Research

- Game planning: Coordinators can scheme their best spin move rushers better looks
  - Optimize participation, since spin moves are used on passing plays
- Scouting: Scouts and coaches can use model to quantitatively aid in their analysis
  - For instance, play-level SHAP values can be used to quantify the exact features leading to a spin move's outcome
  - Detection framework can be used to easily find spin moves, rather than manually sifting through all the film
- Media and Fan Consumption: A quantitative metric for a spin move's execution could be helpful for fan and media consumption, shedding light on spin moves.
  - Supplemented by visual animations of features

Future Improvements:

- Better determine an ideal "cutoff" for determining a spin move
  - 200 degrees within 8 frames is based on a subjective cutoff
- Incorporate other heuristics to better capture spin moves, improve robustness
- Better feature engineering; some unincorporated features could contain valuable information
- Expand this framework to include other types of pass rushing techniques, allowing us to analyze various tradeoffs and relationships