

MARCH 8-10, 2019 ★ PHOENIX, AZ



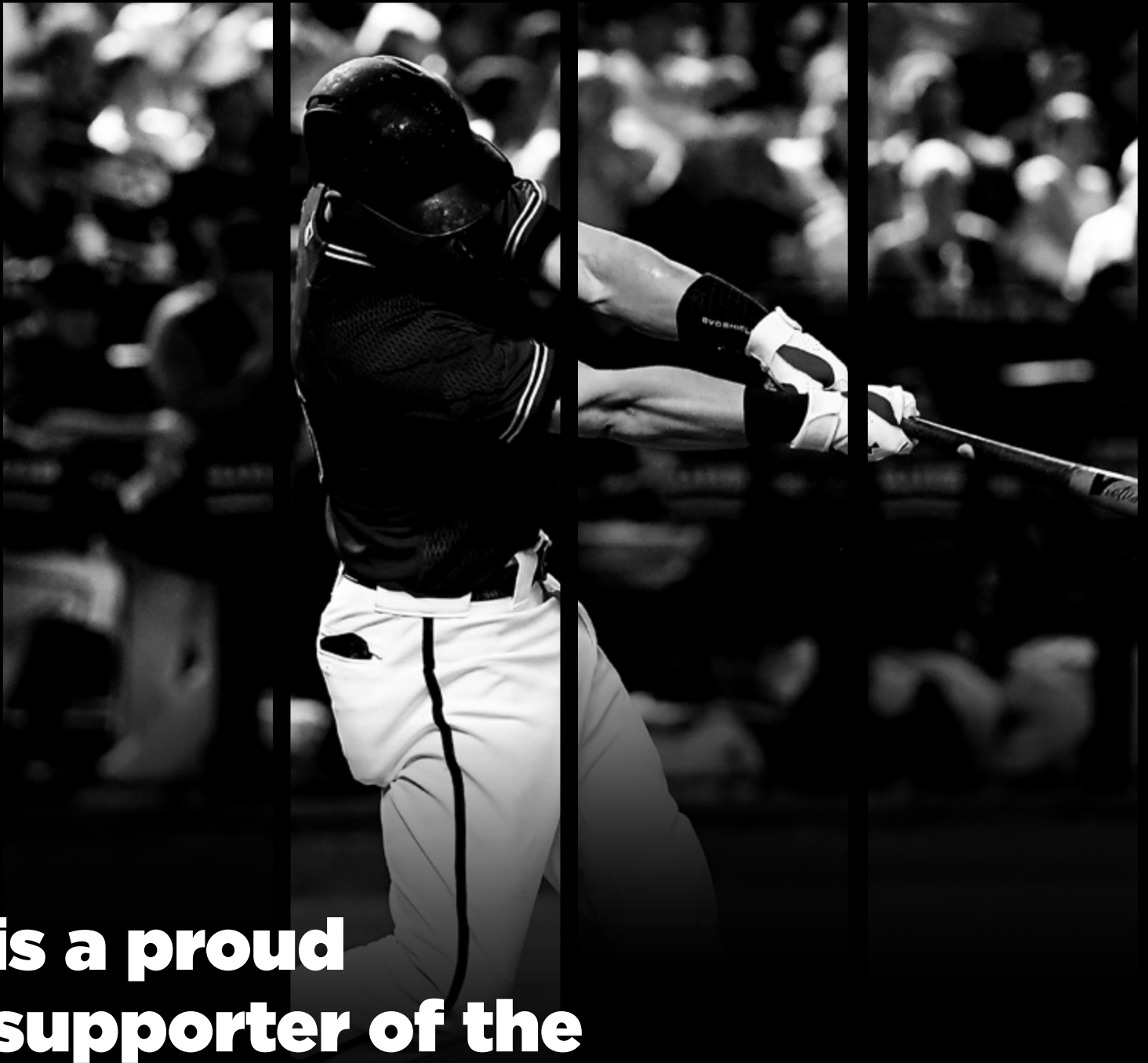
ANALYTICS CONFERENCE



KINATRAX



MAJOR LEAGUE BASEBALL



**is a proud
supporter of the**

SABR Analytics Conference



Welcome!

Welcome to the eighth annual SABR Analytics Conference, presented by MLB and KinaTrax!

In 2019, we have invited another top group of speakers from throughout the baseball industry, including Carlos Peña of MLB Network, ESPN's Eduardo Perez, award-winning author Rob Neyer, John Dewan of Baseball Info Solutions, Kyle Boddy of Driveline Baseball, Arizona Diamondbacks broadcasters Mike Ferrin and Steve Berthiaume, Emilee Fragapane of the Los Angeles Dodgers, Eno Sarris of The Athletic, MLB's Cory Schwartz, Greg Cain, Ben Jedlovec, Mike Petriello, Daren Willman, and Travis Petersen, and many more. We'll also have many research presentations with a wide-ranging, diverse group of speakers throughout the conference.

Each year, the top minds of the baseball analytic community gather to discuss, debate and share insightful ways to analyze and examine the great game of baseball. The event is a natural for SABR. The Society for American Baseball Research has a long and storied history with baseball statistical analysis and is committed to maintaining the link between our name and sabermetrics.

This year's conference will include a combination of guest speakers, panels, and cutting-edge research presentations — plus the unique Diamond Dollars Case Competition, in which undergraduate, graduate, and law school students from across the country analyze and present a real baseball operations decision. We will begin programming early Friday afternoon on March 8 and will run through Sunday afternoon on March 10. Lunch, which is included in your conference registration, will be served at noon on Friday — before the regular programming begins — and also on Saturday between the morning and afternoon sessions.

SABR's long history in this area of baseball research, coupled with our mission of advancing the understanding and the knowledge of baseball, uniquely positions us to coordinate and host such an important baseball industry event.

Once again, we want to thank all of our attendees and our sponsors, which include Major League Baseball, KinaTrax, Baseball Info Solutions, Rawlings, SMT, Baseball-Reference.com, Rapsodo, Mindful Athlete Training, TrinityVR, and the following MLB teams: the Arizona Diamondbacks, Chicago Cubs, Cincinnati Reds, Cleveland Indians, Colorado Rockies, Los Angeles Angels of Anaheim, Los Angeles Dodgers, San Diego Padres, San Francisco Giants, St. Louis Cardinals, and Toronto Blue Jays.

You can visit [SABR.org/analytics](https://sabr.org/analytics) during and after the conference for complete coverage of the 2019 SABR Analytics Conference, including stories, multimedia highlights, and photo galleries.

Vince Gennaro, President, SABR Board of Directors
Scott Bush, SABR Chief Executive Officer

Events Schedule

FRIDAY, MARCH 8

Friday's programming will be held at the Hyatt Regency Phoenix, 122 N. 2nd St., Phoenix, AZ 85004.

♦ **9:30 a.m.-6:00 p.m.: Registration open**

You can pick up your SABR Analytics Conference registration packet in the Regency Ballroom Foyer (1st floor) of the Hyatt Regency Phoenix.

♦ **12:00-1:00 p.m.: Lunch**

(Atrium, 2nd floor)

Analytics Conference registration includes lunch.

♦ **1:00-1:10 p.m.: Conference Welcome: Vince Gennaro/Scott Bush**

(Regency Ballroom, 1st floor)

SABR Board President Vince Gennaro and Chief Executive Officer Scott Bush will welcome attendees.

♦ **1:10-2:00 p.m.: The State of Analytics**

(Regency Ballroom, 1st floor)

Speakers: John Dewan, Baseball Info Solutions; Eduardo Perez, ESPN; Rob Neyer, author and SABRcast host. Moderator: Vince Gennaro, SABR Board President.

♦ **2:00-2:30 p.m.: Research Presentation 1**

(Regency Ballroom, 1st floor)

RP1—Brian Reiff, "The Effectiveness of Strategic Outfield Positioning"

♦ **2:45-3:45 p.m.: Liquid Analytics**

(Regency Ballroom, 1st floor)

Speaker: Carlos Peña, MLB Network.

♦ **4:00-5:00 p.m.: Research Presentations 2-3**

RPs 2-3 will take place back-to-back in a single session.

RP2—Rohan Gupta, "Introducing Pitch Score, Pitch Matrices and Rapscore"

RP3—Andrew Kyne, "Wall Balls: Incorporating the Outfield Wall into Defensive Runs Saved"

♦ **5:00-5:10 p.m.: Introduction to Diamond Dollars Case Competition**

(Phoenix Ballroom, 2nd floor)

SABR Board President Vince Gennaro will introduce the 2019 Diamond Dollars Case Competition in the Phoenix Ballroom on the second floor, with presentations to follow.

♦ **5:15-10:00 p.m.: Diamond Dollars Case Competition**

(Phoenix, Cassidy, Curtis, and Cowboy Artists Ballrooms, 2nd floor)

Presentations of the Diamond Dollars Case Competition. *See page 21 for more information.*

Events Schedule

SATURDAY, MARCH 9

Saturday's programming will be held at the Hyatt Regency Phoenix, 122 N. 2nd St., Phoenix, AZ 85004.

♦ **7:45-8:15 a.m.: Networking Coffee Talk, presented by Rapsodo**
(Gilbert Room, 1st floor)

Grab a cup of coffee while we discuss career paths and network. Networking coffee talks are for industry executives and students looking to get into the game and will include industry job postings.

♦ **8:00 a.m.-5:00 p.m.: Registration open**

You can pick up your SABR Analytics Conference registration packet in the Regency Ballroom Foyer (1st floor) of the Hyatt Regency Phoenix.

♦ **8:30-9:30 a.m.: Keeping Data Flowing**
(Regency Ballroom, 1st floor)

Speakers: Kyle Boddy, Driveline Baseball; Joe Rosales, Baseball Info Solutions.

Moderator: Mike Ferrin, Arizona Diamondbacks/MLB Network Radio.

♦ **9:45-10:45 a.m.: Research Presentations 4-5**
(Regency Ballroom, 1st floor)

RPs 4-5 will take place back-to-back in a single session.

RP4—Vince Gennaro, "Pitching: The Power of Pitch Sequencing vs. Stuff"

RP5—Alan Nathan, "Optimizing the Swing: A Physics-Based Approach"

♦ **11:00 a.m.-12:00 p.m.: Training Pitchers**
(Regency Ballroom, 1st floor)

Speakers: Dr. Steven Cadavid, KinaTrax; Seth Daniels, Rapsodo; former major-league pitcher and coach Scott Radinsky; Eno Sarris, The Athletic. Moderator: Steve Berthiaume, Arizona Diamondbacks.

♦ **12:00-1:00 p.m.: Statcast Year Five: Where Are We Now?**
(Regency Ballroom, 1st floor)

Speakers: Greg Cain, Travis Petersen, Cory Schwartz, and Daren Willman of MLB.

Moderator: Ben Jedlovec, MLB.

♦ **1:00-1:45 p.m.: Lunch**
(Atrium, 2nd floor)

Analytics Conference registration includes lunch.

♦ **2:00-2:30 p.m.: SABR Analytics Conference Lifetime Achievement Award Presentation**
(Regency Ballroom, 1st floor)

Sabermetric pioneer Dick Cramer will be honored with the SABR Analytics Conference Lifetime Achievement Award.

Events Schedule

♦ **2:30-3:30 p.m.: Research Presentations 6-7**

(Regency Ballroom, 1st floor)

RPs 6-7 will take place back-to-back in a single session.

RP6—Jonathan Judge, “A Theory of Expected Performance”

RP7—Glenn Healey, “Spin Signatures for Pitcher Evaluation and Development”

♦ **3:45-4:15 p.m.: Lidar and Ground Truth Testing**

(Regency Ballroom, 1st floor)

Speaker: Clay Nunnally, MLB.

♦ **4:15-5:15 p.m.: Diamond Dollars Case Competition**

(Regency Ballroom, 1st floor)

Encore presentation from the winning team of the Diamond Dollars Case Competition.

♦ **5:30-7:30 p.m.: Networking Reception with Baseball Industry Network, presented by KinaTrax**

(Garden Terrace, 3rd floor)

The networking reception will be an opportunity for conference attendees to meet some of our panelists, speakers, writers and others working throughout the baseball industry. Cash bar.

SUNDAY, MARCH 10

Sunday’s programming will be held at the Hyatt Regency Phoenix, 122 N. 2nd St., Phoenix, AZ 85004.

♦ **7:45-8:15 a.m.: Networking Coffee Talk, presented by Rapsodo**

(Gilbert Room, 1st floor)

Grab a cup of coffee while we discuss career paths and network. Networking coffee talks are for industry executives and students looking to get into the game and will include industry job postings.

♦ **8:00 a.m.-2:00 p.m.: Registration open**

You can pick up your SABR Analytics Conference registration packet in the Regency Ballroom Foyer (1st floor) of the Hyatt Regency Phoenix.

♦ **8:30-9:30 a.m.: Research Presentations 8-9**

(Regency Ballroom, 1st floor)

RPs 8-9 will take place back-to-back in a single session.

RP8—Ayane Kusafuka, “The Relationship Between Release Parameters and Pitch Location in Baseball Pitching”

RP9—Rob Mains, “Modern Roster Construction, Payroll Considerations, and the Next Collective Bargaining Agreement”

Events Schedule

♦ **9:30-10:30 a.m.: Game Within a Game**

(Regency Ballroom, 1st floor)

Speakers: Emilee Fragapane, Los Angeles Dodgers; Dr. Lee Picariello, Mindful Athlete Training; Julian Volyn, TrinityVR. Moderator: Rob Neyer, author and SABRcast host.

♦ **10:45-11:45 a.m.: Research Presentations 10-11**

(Regency Ballroom, 1st floor)

RPs 10-11 will take place back-to-back in a single session.

RP10—Clinton Hausman, Michael Shames, and Bradley Waddell, “Optimal Fielder Positioning Model”

RP11—Kevin Antonevich, “Pitch Sequence Optimization in Major League Baseball”

♦ **11:45 a.m.-12:00 p.m.: SABR Analytics Conference Research Award presentations**

(Regency Ballroom, 1st floor)

The winners of the 2019 SABR Analytics Conference Research Awards will be announced and presented.

♦ **12:15-12:45 p.m.: Research Presentation 12**

(Regency Ballroom, 1st floor)

RP12—Daniel Calzada, “DeepBall: Modeling Expectation and Uncertainty with Recurrent Neural Networks”

♦ **12:45-1:45 p.m.: Use of Analytics in Broadcast Media**

(Regency Ballroom, 1st floor)

Speakers: Eduardo Perez, ESPN; Mike Petriello, MLB; Mike Ferrin, Arizona Diamondbacks/MLB Network Radio.

♦ **1:45-2:00 p.m.: Conference wrap-up**

(Regency Ballroom, 1st floor)

SABR Board President Vince Gennaro and Chief Executive Officer Scott Bush.

Please note: All speakers and panelists are subject to change due to availability.

Speakers/Panelists

Conference Welcome: Vince Gennaro and Scott Bush

1:00 p.m., Friday, March 8, Regency Ballroom, 1st floor

♦ **Vince Gennaro** is the President of SABR's Board of Directors, author of *Diamond Dollars: The Economics of Winning in Baseball*, and host of a weekly national radio show, *Behind the Numbers: Baseball SABR Style on SiriusXM*. He is also the Associate Dean and Clinical Associate Professor of NYU's Preston Robert Tisch Institute for Global Sport. He is a consultant to MLB teams and appears regularly on MLB Network. He is also the architect of the Diamond Dollars Case Competition series, which brings together students and MLB team and league executives and serves as a unique learning experience, as well as a networking opportunity for aspiring sports executives.

♦ **Scott Bush** is SABR's Chief Executive Officer. He joined the organization in 2018 after serving as the Senior Vice President for Business Development with the Goldklang Group. His demonstrated commitment to creativity and his established track record of generating revenue, cultivating new markets, and collaborating with a wide range of stakeholders make Bush an ideal fit for the next stage of SABR's evolution within the baseball ecosystem. Since graduating from the University of Minnesota, Bush held positions with increasing responsibilities in both sports and media, including a five-year stint as Assistant General Manager for the St. Paul Saints, where he played a key role in establishing CHS Field in St. Paul, Minnesota.

The State of Analytics

1:10 p.m., Friday, March 8, Regency Ballroom, 1st floor

On the evolution of data availability, player evaluation, and player development in the age of analytics.

♦ **Eduardo Perez** is a baseball analyst for ESPN. He was the Houston Astros' bench coach in 2013 after two seasons as the Miami Marlins' hitting coach. He has served as manager of the Colombian national team and as manager and general manager of the Puerto Rican national team. From 1993-2006, Eduardo played parts of 13 seasons in the Major Leagues, primarily as a first baseman, for the Angels, Cardinals, Reds, Devil Rays, Indians and Mariners. He joined ESPN as an analyst for the 2006 postseason and worked full-time for the network for the next four seasons. He is the son of Hall of Famer Tony Perez.

♦ **John Dewan** is the owner of Baseball Info Solutions, which collects, analyzes and disseminates the most in-depth data in the industry with more than a dozen Major League Baseball teams as clients. He is also the co-publisher of ACTA Sports, a division of ACTA Publications, which publishes books on statistical baseball analysis, including the annual *Bill James Handbook* and other sports titles. John's multi-volume set of *The Fielding Bible* books break new ground in an area that has been the least analyzed in baseball: defense. His Plus/Minus System and Defensive Runs Saved are a direct application of actuarial and sabermetric techniques. Before founding BIS, John was President and CEO of STATS, Inc., following a highly successful career as an insurance actuary.

♦ **Rob Neyer** is a longtime baseball writer and editor for ESPN.com, SB Nation, and FoxSports.com. Rob began his career as a research assistant for groundbreaking baseball author Bill James,

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and later worked for STATS, Inc. He has also written or co-written seven baseball books, including *The Neyer/James Guide to Pitchers* (with Bill James), winner of the Sporting News/SABR Baseball Research Award, and most recently *Power Ball: Anatomy of a Modern Baseball Game*, which won this year's CASEY Award. He is the host of the new weekly podcast, *SABRcast with Rob Neyer*, which launches in the spring of 2019.

♦ **Moderator: Vince Gennaro**, President, SABR Board of Directors

Liquid Analytics

2:45 p.m., Friday, March 8, Regency Ballroom, 1st floor

♦ **Carlos Peña** is an analyst at MLB Network and a former All-Star first baseman. He spent 14 seasons in the major leagues, hitting 286 home runs for eight teams. With the Tampa Bay Rays, he won a Silver Slugger Award with 46 home runs in 2007 and helped lead the team to the American League pennant in 2008. He joined MLB Network in 2014 and appears regularly on "MLB Tonight," "Play Ball," and other programming.

Keeping Data Flowing

8:30 a.m., Saturday, March 9, Regency Ballroom, 1st floor

How do teams take information from their analytics departments to coaches and, ultimately, players?

♦ **Kyle Boddy** is the founder and owner of Driveline Baseball and a consultant for major-league teams. Driveline has provided advanced pitching research, rehabilitative services, and player development services to amateur and professional players including Trevor Bauer and Dan Straily. Prior to founding Driveline in 2008, Kyle was founder of Liquid Voltage Consulting, where he was a data analyst and software developer for a variety of companies, including Microsoft and Rational Entertainment Industries (PokerStars).

♦ **Joe Rosales** is Vice President of Research and Development for Baseball Info Solutions. He is a New England native who found his way to BIS after internships in baseball operations with the Boston Red Sox, Pittsburgh Pirates, and New York Mets. He is also a winner of the MIT Sloan Sports Analytics Conference Research Competition for the development of BIS's Strike Zone Runs Saved pitch framing methodology. He earned his bachelor's degree in Civil Engineering from Columbia University and a dual MBA/M.S. Degree in Sports Management from the University of Massachusetts, Amherst.

♦ **Moderator: Mike Ferrin** is entering his fourth season on the Arizona Diamondbacks radio broadcast team, as the pre- and postgame show host and secondary play-by-play announcer on Arizona Sports 98.7 FM and the Arizona Diamondbacks Radio Network. Since 2007, he has worked as a nationally renowned broadcaster on SiriusXM MLB Network Radio as the host of "Power Alley" and the on-site host in the MLB postseason and Winter Meetings. Previously, he was the play-by-play announcer for the Double-A Bowie Baysox and a sports producer and reporter for WGN Radio in Chicago.

Speakers/Panelists

Training Pitchers

11:00 a.m., Saturday, March 9, Regency Ballroom, 1st floor

How has the evolution of innings demands changed how pitchers train?

- ♦ **Dr. Steven Cadavid** is the president and owner of KinaTrax, and the principal developer of the company's markerless motion capture system. He has authored more than 20 peer-reviewed articles related to biometric recognition. He holds a Ph.D. in Electrical and Computer Engineering with a specialization in computer vision and machine learning from the University of Miami. Previously, he was the Chief Technology Officer and Co-Founder of Eyeris Technologies.
- ♦ **Seth Daniels** is the Director of Sales and Marketing for Rapsodo, where he focuses on building data-driven technologies to provide players and coaches with real-time tracking solutions and helps develop market strategies for the North American market. He holds a bachelor's degree in marketing communications and an MBA from Anderson University.
- ♦ **Scott Radinsky** is a former major-league pitcher who spent 11 seasons as a hard-throwing left-handed reliever with the Chicago White Sox, Los Angeles Dodgers and two other teams between 1990 and 2001. He has spent the past two decades as a pitching and bullpen coach with the Cleveland Indians, Dodgers, and most recently the Los Angeles Angels, with whom he served as bullpen coach from 2016 to 2018 and monitored TrackMan data for the team. In addition to his baseball life, he is the lead singer of the punk rock band Pulley and owns the Skatelab skateboard park outside of Los Angeles.
- ♦ **Eno Sarris** is a staff writer for The Athletic, where he specializes in pitching analytics. He takes the best public analytics findings to the players in the clubhouse to get their reactions. He has also been a contributor to FanGraphs, ESPN, MLB.com, Fox Sports, SB Nation, The Hardball Times, and others.
- ♦ **Moderator: Steve Berthiaume** is entering his seventh season as the Arizona Diamondbacks' television play-by-play voice on Fox Sports Arizona alongside analyst Bob Brenly. He previously spent 12 years at ESPN as a "SportsCenter" anchor from 1999-2005 and 2007-12 as studio host for the award-winning "Baseball Tonight" while also working as a play-by-play announcer for ESPN's league-wide MLB package as well as the College World Series Super Regional.

Statcast Year Five: Where Are We Now?

12:00 p.m., Saturday, March 9, Regency Ballroom, 1st floor

- ♦ **Greg Cain** is Vice President of Baseball Data for Major League Baseball. Since joining MLB in 2011, he has been instrumental in the development of the Statcast system, leading to its league-wide launch in 2015. He holds a degree in Management Information Systems and Services from the University of Oklahoma.
- ♦ **Travis Petersen** is a Senior Data Scientist at Major League Baseball and an adjunct professor at Fordham University. He previously worked at IBM and has a master's degree in Business Analytics from Fordham University.

Speakers/Panelists

- ♦ **Cory Schwartz** is the Vice President of Data Operations for Major League Baseball, overseeing the team responsible for live data capture for the official stats for all MLB, minor league, and winter league baseball games. In 2014, he was the recipient of SABR's Henry Chadwick Award, honoring baseball's greatest researchers for their contributions to the game. Prior to joining MLB in 2001, Schwartz also worked for the New York Yankees and the National Basketball Association.
- ♦ **Daren Willman** is the Director of Baseball Research and Development for Major League Baseball, where he spearheads socially fan driven content featuring Statcast in his work. He developed the popular data websites BaseballSavant.com, MLBfarm.com, and NFLsavant.com. Previously, he was the lead software architect at the Harris County District Attorney's Office in Houston.

Lidar and Ground Truth Testing

3:45 p.m., Saturday, March 9, Regency Ballroom, 1st floor

- ♦ **Clay Nunnally** began working in January 2018 as a Baseball Scientist at Major League Baseball. Since 2008, he served as the Chief Operating Officer at Applied Physical Electronics. He holds a bachelor's degree in physics from Abilene Christian University, a master's degree in engineering physics from the University of Virginia, and a Ph.D. in electrical engineering from the University of Missouri.

Game Within a Game

9:30 a.m., Sunday, March 10, Regency Ballroom, 1st floor

How are data-driven decisions impacted by the ability to adapt?

- ♦ **Emilee Fragapane** is a Baseball Operations Coordinator with the Los Angeles Dodgers. She holds a master's degree in economics from the University of California at Santa Barbara and a bachelor's degree in quantitative microeconomics from California State University at Sonoma. She joined the Dodgers front office as a baseball operations intern in 2013 and as a full-time baseball research analyst in 2014.
- ♦ **Dr. Lee Picariello** is the owner and operator of Mindful Athlete Training, a holistic mental strength training program for elite athletes. A former All-American football player and record holder at Lehigh University, he has earned both a Master's degree and a PsyD in Clinical Psychology from LaSalle University in Philadelphia. He has also developed bioQ, a mental skill metric for holistic integration in sports analytics. A sport performance psychologist and an expert in Holistic Performance Theory, his research explores the impact of mental fatigue on perceived exertion and he has co-authored the white paper, *Integration Effect: The Leveraging of Physiological Systems for Peak-Performance* (2018).
- ♦ **Julian Volyn** is the Co-Founder and Chief of Product for TrinityVR, a virtual-reality startup developing the DIAMONDF/X baseball training simulation system. He is also a Senior XR Product Manager with AT&T, leading product strategy and execution with the company's

Speakers/Panelists

Media + Entertainment Group. He holds a bachelor's degree in Electronic Arts and Tech Entrepreneurship and a master's degree in Technology, Commercialization and Entrepreneurship from Rensselaer Polytechnic Institute.

♦ **Moderator: Rob Neyer**, author and SABRcast host

Use of Analytics in Broadcast Media

12:45 p.m., Sunday, March 10, Regency Ballroom, 1st floor

Can the NL Wild Card Game's "Nerdcast" be used as a template moving forward?

♦ **Mike Petriello** is a stats analyst for Major League Baseball and writes daily about Statcast and advanced metrics for MLB.com and each of the 30 club sites, bringing the latest in stats to the baseball public. He can also regularly be seen on MLB Network, is the host of the Statcast Podcast. Prior to joining MLB, he wrote for FanGraphs and ESPN.

♦ **Eduardo Perez**, ESPN baseball analyst

♦ **Mike Ferrin**, Arizona Diamondbacks broadcaster

Research Presentations

SABR and Baseball Info Solutions are pleased to announce the research presentations that will be delivered at the eighth annual SABR Analytics Conference. Most presentations will be delivered back-to-back in hour-long single sessions.

All presentations will be held in the **Regency Ballroom on the 1st floor of the Hyatt Regency Phoenix**. Here is the schedule of research presentations for the 2019 SABR Analytics Conference:

Research Presentation 1 2:00-2:30 p.m., Friday, March 8

RP1— Brian Reiff, “The Effectiveness of Strategic Outfield Positioning”

About a decade ago, teams started consistently repositioning their infielders to counter batters with extreme groundball tendencies, often moving three or more infielders to one side of the field to prevent a potential base hit. A similar trend has taken off in the outfield, as teams are starting to move their outfielders more and more to counter a batter’s flyball tendencies. Using Statcast data, Baseball Info Solutions has analyzed these movements to get a better idea of how teams are employing this tactic. This presentation will address teams’ usage of strategic outfield positioning and how it has changed over the years for which data is available. It will also explore the strategy’s effectiveness at different magnitudes and against different groups of hitters.

Brian Reiff is a Research Associate at Baseball Info Solutions. He initially joined the R&D group as an intern during his senior year of school at Lehigh University and became a full-time member of the staff after graduating in May 2017.

Research Presentations 2-3 4:00-5:00 p.m., Friday, March 8

RP2 and RP3 will take place back-to-back in a single session.

RP2—Rohan Gupta, “Introducing Pitch Score, Pitch Matrices, and Rapscore”

Currently, scouting is fairly subjective, based largely on the “eye test.” Teams grade players on certain tools according to the 20-80 scale, where 50 is major league average and 10 represents one standard deviation. In particular, pitchers are graded by each of their pitch types, as well as other overarching descriptive qualities. The method has several drawbacks. Primarily, the subjective nature of the art means that each scout will have his own grading standards. Even when data is used in grading, it is limited in scope. While velocity is a starting point, other components influence the effectiveness of certain pitches, such as command, movement and deception, so it makes sense to formalize these components.

Using 882,717 pitches thrown by Rapsodo users and 7,747,112 pitches thrown in MLB since 2008 (via Statcast), we are able to more holistically understand the variables that affect pitch quality. The pitch score metric will allow us to grade individual pitches quickly and objectively. It was created by modeling measures of velocity, movement and location to predict the likelihood of a swinging strike, since we wanted to best evaluate a pitcher’s “stuff” in terms of his ability to deceive and overpower hitters.

Research Presentations

We also developed four supplementary statistics to visualize and quantify the interaction between a player's pitch types in terms of location, movement, release and velocity, called the pitch matrices. Each tool can be used to impartially evaluate thousands of pitchers at every level — MLB, college, high school and youth — and creatively to aid in player development: Pitchers and coaches can receive instantaneous feedback, gauge progress and generate training plans.

Rohan Gupta is a senior at Washington University in St. Louis majoring in mathematics and economics and strategy. He and the Washington University team won the Diamond Dollars Case Competition at the 2018 SABR Analytics Conference. Currently a sports analytics intern with Rapsodo, he will join the New York Yankees as a baseball operations associate in June 2019.

RP3—Andrew Kyne, “Wall Balls: Incorporating the Outfield Wall into Defensive Runs Saved”

Plays at the outfield wall are inherently difficult. The presence of a physical obstacle alters the approach fielders must take to get to the ball. They cannot always continue running at full speed and sometimes must leave their feet to make the play. Using batted ball data and wall distance measurements, Baseball Info Solutions (BIS) quantified this difficulty and found that plays within three feet of the wall are converted into outs much less frequently than similar flyballs that are further from the wall. Correspondingly, it was found that the expected out rates on those plays were being overestimated in the company's Defensive Runs Saved (DRS) metrics. As a result, outfielders tended to be penalized too much for not making plays at the wall and not be rewarded enough when they did. This presentation will discuss that research and how to incorporate the wall into outfield defense evaluation.

Andrew Kyne is a Research Associate at Baseball Info Solutions. He is a 2018 graduate of Duquesne University, where he studied Information Systems and Economics. While in college, he interned in R&D with BIS and in Baseball Informatics with the Pittsburgh Pirates.

Research Presentations 4-5

9:45-10:45 a.m., Saturday, March 9

RP4 and RP5 will take place back-to-back in a single session.

RP4—Vince Gennaro, “Pitching: The Power of Pitch Sequencing vs. Stuff”

Analysts often attribute pitch outcomes (e.g., quality of contact, swinging strikes, called strikes, etc.) to the characteristics of a given pitch. Others will argue that pitch outcomes are highly dependent on context, such as a sequence of pitches leading up to an outcome, represented by their characteristics and differences from one another. This analysis attempts to assess and isolate the impact of the current pitch and the previous pitch, on the outcome of a pitch. The analysis also attempts to identify MLB pitchers who are “sequencers” — where outcomes are highly dependent on the current and previous pitch.

Vince Gennaro is the President of SABR's Board of Directors, author of *Diamond Dollars: The Economics of Winning in Baseball*, and host of a weekly national radio show, *Behind the Numbers: Baseball SABR Style on SiriusXM*. He is also the Associate Dean and Clinical Associate Professor of NYU's Preston Robert Tisch Institute for Global Sport. He is a consultant to MLB teams and appears regularly on MLB Network. He is also the architect of the Diamond Dollars Case Competition series, which brings together students and MLB team and league executives and serves as a unique learning experience, as well as a networking opportunity for aspiring sports executives.

Research Presentations

RP5—Alan Nathan, “Optimizing the Swing: A Physics-Based Approach”

In the past decade, physics-based models for the ball-bat collision have progressed to the point that they can reliably predict exit velocity, launch angle, and spin axis — and perhaps less reliably, spin rate — of the batted ball if the properties of the swing, pitch, and impact are known, largely based on laboratory experiments done under controlled conditions. The swing properties include the orientation, attack angle, and speed of the bat; the pitch properties include the speed, spin, spin axis, and approach angle of the ball; and the impact parameters include the location on the surface of the bat where the collision occurs. In a series of articles from several years ago, several simplifying assumptions for the batter’s swing were used to investigate how a batter might optimize the swing parameters, particularly the attack angle, to obtain certain outcomes, such as high on-base probability or maximum fly ball distance.

The primary goal of this talk is to develop this topic further by relaxing the simplifying assumptions used in the earlier analysis. First, the latest laboratory experiments used to develop the collision model will be reviewed, mainly to give a flavor for how we know — and how well we know — what we know. Next, the results of new calculations will be discussed, in the context of showing how exit velocity, launch angle, direction, and spin axis are related to the swing and pitch parameters. Finally, the calculations will be used along with Statcast data to address the “reverse engineering” problem, addressing the question of whether batted ball data can be used to infer — or at least constrain — the parameters of the batter’s swing, with particular emphasis on the attack angle.

Alan Nathan is Professor Emeritus of Physics at the University of Illinois. After a long career doing experimental nuclear physics, he now spends his time doing research on the physics of baseball. On this topic he has written many articles, both for academic journals and online baseball publications; he has given numerous talks to a variety of different audiences; and he maintains an oft-visited website, baseball.physics.illinois.edu, that many people have found to be a useful resource. He is interviewed regularly by the media and has consulted for various organizations, such as MLB, USA Baseball, NCAA, and several MLB clubs.

Research Presentations 6-7

2:30-3:30 p.m., Saturday, March 9

RP6 and RP7 will take place back-to-back in a single session.

RP6—Jonathan Judge, “A Theory of Expected Performance”

First there was batting average, then on-base percentage. Dick Cramer and then Pete Palmer focused on On-Base-Plus-Slugging or OPS, and subsequent work by Tom Tango et al brought us weighted on base average or wOBA. We develop a unified theory to demonstrate how a baseball statistic’s performance can be evaluated, which demonstrates the improvement in accuracy brought by each generation of baseball statistics.

We isolate the performance of a baseball statistic into three Contribution Measures: Descriptiveness (correlation to same-season run-scoring), Reliability (correlation to next year’s ratings of the same players), and Predictiveness (correlation to next season’s run-scoring). We will show that each of baseball’s best known statistics have different levels of performance in these measures, that the best of them manage to exceed previous efforts in all three categories, and that park-adjusted statistics follow a similar hierarchy.

Research Presentations

We conclude with an introduction to DRC+, a new statistic from Baseball Prospectus that maximizes all three Contribution Measures better than any other park-adjusted statistic. DRC+ aims to estimate a player's expected contribution, and its performance in the Contribution Measures notably exceeds most competing statistics. The performance of DRC+ raises new and interesting questions about what additional areas of study can help us better understand hitter contributions in baseball.

Jonathan Judge has a degree in piano performance from the Lawrence University Conservatory of Music and a law degree from the University of Wisconsin. He is a trial lawyer specializing in the defense and regulation of consumer products. He is a senior member of the Stats Team at Baseball Prospectus, and has been heavily involved in the rollout of mixed modeling to drive a new generation of baseball statistics. He believes that analytics can play an important role in driving better legal decisions.

RP7—Glenn Healey, “Spin Signatures for Pitcher Evaluation and Development”

The Trackman radar allows recovery of three-dimensional pitch and batted ball trajectories which have been used by machine learning techniques to quantify the run value of a pitch as a function of variables that include velocity, location, and movement. This has led to the definition of pitcher statistics that are independent of outcomes and contextual variables such as the defense, ballpark, umpire, and catcher and that can be used to directly compare pitchers across environments. Beyond its use for pitcher evaluation, this approach provides a quantitative framework to guide pitcher development and pitch design. An important component of this framework is the ability to relate pitch trajectory parameters to characteristics of a pitcher's delivery. Pitch movement, for example, is a complicated function of the forces on a baseball when it leaves the pitcher's hand and the atmospheric conditions. Since the Trackman system measures a pitch's total spin along with trajectory information, we can separate the factors that contribute to movement.

We leverage a computational process proposed by Alan Nathan in combination with fine-grained weather data to analyze the movement of every MLB pitch thrown over a full season. This effort has led to an improved physical model for the relationship between the lift coefficient and the scaled spin parameter (Bauer units). This relationship determines pitch movement and is exploited by a robust process to recover the useful spin, spin efficiency, and spin axis for each pitch type thrown by each MLB pitcher. These recovered parameters are used to define the spin diagram for an individual pitch type in terms of the direction of the Magnus force and the spin efficiency. The information in spin diagrams is combined to define the spin signature for a pitcher's collection of pitches. In addition to their utility for pitcher evaluation and development, spin signatures can be used by projection systems to model the aging characteristics associated with different pitcher types. The new approach can also be used to assist with sensor calibration and pitch classification and to analyze the effects of altitude and weather on pitch characteristics.

Glenn Healey is a professor of electrical engineering and computer science at the University of California, Irvine where he is director of the computer vision laboratory. He received the B.S.E. degree in Computer Engineering from the University of Michigan and the M.S. degree in computer science, the M.S. degree in mathematics, and the Ph.D. degree in computer science from Stanford University. Dr. Healey's professional life is dedicated to combining physics, statistical signal processing, and machine learning methods for the development of algorithms that extract information from large sets of data.

Research Presentations

Research Presentations 8-9

8:30-9:30 a.m., Sunday, March 10

RP8 and RP9 will take place back-to-back in a single session.

RP8—Ayane Kusafuka, “The Relationship Between Release Parameters and Pitch Location in Baseball Pitching”

In pitching, the skill to control a ball to a target position accurately is one of the most important skills. Both mechanical and neural mechanisms relating to the pitch accuracy are not entirely clear, although many studies have attempted to understand it from different points of view. The objective of this study is to understand the mechanism of pitching accuracy; in particular, the influence of the mechanical parameters at ball release, which are called the release parameters in this study, on the pitch location.

With recent advances in science and technology, measurement equipment has made remarkable progress and made it possible to measure various parameters and the trajectory of the ball with high accuracy on real time. In this study, which parameter is important for pitch location is investigated by measuring parameters by TrackMan and developing a simulation that predicts the pitch location from these measured parameters. Comparing the variation of the pitch location caused by changing various release parameters on the simulation, and verifying using multiple regression analysis, it was found that the parameters affecting the vertical pitch location were the elevation pitching angle and velocity, i.e., the velocity vector of the ball, and the parameters estimating the horizontal pitch location were identified as the azimuth pitching angle and horizontal release point. Further, it is possible to say that the vertical release point is not the factor that determines the pitch location directly, but one of approaches to adjust the velocity vector. Moreover, a regression model using only the elevation pitching angle and velocity was prepared in the vertical pitch location, and it showed similar results for every pitcher. This indicates that elevation pitching angle and velocity are common factors in determining the pitch location, and the other parameters, such as the release point, are less critical and different with each pitcher. This study revealed the influence of each release parameter on the pitch location by combining the measured data, the computer simulation, and the statistical analysis, and is expected to contribute to understanding the neural mechanisms underlying accurate ball control skills. It may lead to the establishment of appropriate training and teaching methods.

Ayane Kusafuka is a master course student in Department of Life Science, Graduate School of Arts and Sciences at the University of Tokyo. She received a bachelor’s degree in Engineering from Waseda University, Tokyo. Her research theme is to understand the mechanism underlying pitching accuracy from the viewpoint of biomechanics and neuroscience.

RP9— Rob Mains, “Modern Roster Construction, Payroll Considerations, and the Next Collective Bargaining Agreement”

Many analysts have noted that baseball is benefiting from the contributions of young players who are promoted rapidly through the minor leagues and given full-time jobs. The influx of young talent, while exciting, has changed the calculus of team payrolls. Players with less than three years’ service time have no bargaining leverage with their employer, other than a floor of a major-league minimum salary. Players with at least three but fewer than six years of service time can file for binding salary arbitration. Once a player has six years’ service time he is eligible for free agency once his contract expires.

Research Presentations

Young players lacking arbitration rights will receive the major league minimum salary of \$555,000 this season unless they can negotiate a higher figure. Some observers have expressed concern that a large pool of young talent is driving down club payrolls at a time in which baseball is generating record revenues, healthy operating margins, and unprecedented franchise values.

This study examines service time data from 2008 to 2018 to identify trends in player seniority. The key driver from a payroll perspective is not youth, but service time. Max Muncy was a breakout star for the Dodgers last year, but as a minor-league free agent signed by the club and called up last April, he made only about seven percent as much as teammate Yasiel Puig, who is about three months his junior, because of differences in service time. I examined service time averages for each season as well as the percentage of players falling into various service time cohorts. I also considered the differences between hitters and pitchers to determine the impact of the gradual shift in rosters away from position players and toward pitchers.

The results are useful not only to help understand the financial implications of service time trends but also to identify what are likely to be key points of contention when the current collective bargaining agreement expires on December 1, 2021.

Rob Mains is a writer for Baseball Prospectus. His “Flu-Like Symptoms” column runs twice a week. He is a former equities analyst and was a finalist for the 2018 SABR Analytics Conference Research Award for Historical Analysis/Commentary.

Research Presentations 10-11

10:45-11:45 a.m., Sunday, March 10

RP10 and RP11 will take place back-to-back in a single session.

RP10— Clinton Hausman, Michael Shames, and Bradley Waddell, “Optimal Fielder Positioning Model”

There is substantial research regarding shifting and offensive and defensive strategies around the shift. There does not, however, appear to be much (if any) public research concerning where to position fielders from a defensive management standpoint. The goal of this research was to create a model which optimizes the positioning of a team’s fielders for the best defensive output based on a given hitter’s batted ball data.

This model was created with the hope of being able to build a tool which managers can use to align their fielders optimally based on the match-up with the specific batter the team is facing. To convert this defensive management decision problem into a mathematical model, we partitioned the field in 96 segments and modeled these segments as a graph, ultimately computing a total “contribution score” that a player positioned in a particular segment could have in all of the other segments. The contribution score consisted of fielder- dependent measures as well as fielder-independent measures to mitigate the endogeneity of the fielder positions present in the outcomes for batted ball data.

Fielder-independent measures included exit velocity and launch angle of each batted ball, batted ball density in each segment, compiled in one aggregate severity score for each segment, while fielder-dependent measures included distance between segments and the angle to the ball from each segment (representing the distance a fielder would have to run to track down a ball in another segment and the angle at which the fielder would have to run for that ball, respectively).

We decided to do this optimization process for three subjects of interest: Mike Trout, Brian Dozier, and

Research Presentations

Christian Yelich. Our results are the contribution-maximizing seven fielder coordinates which the model would prescribe the defense for each hitter. Such information would contribute greatly to the field of baseball analytics from the perspective of defensive management.

Additionally, and more related to the advancement of baseball analytics as a field, this research demonstrates the need for fielder position data to be tracked on a pitch-by-pitch basis so that future improvements can be made in this space, opening up opportunities for a new class of analyses for future modeling and research.

Clinton Hausman is a senior at Tufts University majoring in Biology and minoring in History. He discovered an interest in sabermetrics after taking Andy Andres' class at Tufts this past fall. He will be attending graduate school for Biology in the fall.

Michael Shames is a junior at Tufts University majoring in Economics and minoring in Philosophy. At Tufts, he serves as president of Baseball Analysis at Tufts (BAT) and is also an editor for *The Tufts Daily*. Last fall, he captained the Tufts team to a first-place finish in SABR's regional Diamond Dollars Case Competition at New York University. He became interested in sabermetrics when he realized he could not hit a fastball over 80 mph.

Bradley Waddell is a senior at Tufts University studying Applied Math and Economics. His interest in sabermetrics stems from both his time playing baseball through high school as well as his passion for analytics. He will be working for Deloitte Consulting after graduation.

RP11— Kevin Antonevich, “Pitch Sequence Optimization in Major League Baseball”

Pitch sequencing has historically been a difficult aspect of baseball to analyze, as the interdependence of pitcher-specific, batter-specific and context-based factors make properly assigning credit or blame for the outcome of a pitch or plate appearance challenging. Previous research has supported traditional beliefs that changing pitch speeds and heights on successive pitches leads to more favorable outcomes for pitchers. The introduction of tunneling metrics into public research in the past few years has shed further light on how pitchers are able to deceive hitters and maximize the performance of their pitches. While these analyses help us better understand pitch sequencing along specific dimensions, it's difficult to estimate their aggregate impact and how they'll apply to a specific pitcher. In an attempt to produce a holistic study of pitch sequencing and aggregate the individual components identified in previous research, I model the probability of a swinging strike based on the physical characteristics and locations of both a single pitch and the pitch preceding it. Using these models, I construct a program that sequentially generates the optimal sequence of pitch types and locations for a specific batter-pitcher matchup, maximizing expected swinging strike rate at each iteration. While analyzing one optimized sequence shows a potential approach for a pitcher in a specific matchup, generating many sequences while holding the batter constant, for example, could expose a specific batter's strengths and weaknesses against particular combinations of pitch types and locations. It can help us answer questions such as, “After a first-pitch fastball to Mike Trout, is it better to throw an average curveball or an elite changeup low in the strike zone?” or “Assuming a certain level of pitch quality, what sequences does the program expect Aaron Judge to struggle against?” I believe that such research has numerous applications and potential extensions in baseball to help us further understand this complex area of the sport.

Kevin Antonevich is a senior at William & Mary studying Applied Mathematics and Economics. He is passionate about leveraging quantitative and qualitative analytical techniques to better understand athlete performance in a variety of sports, specifically in baseball. Kevin has previously worked as a Quantitative

Research Presentations

Analyst Intern with the Philadelphia Phillies and will be joining the Baltimore Orioles' front office as a Baseball Analytics Fellow after graduation this spring.

Research Presentation 12 12:15-12:45 p.m., Sunday, March 10

RP12— Daniel Calzada, “DeepBall: Modeling Expectation and Uncertainty with Recurrent Neural Networks”

Making reliable player preseason predictions is an issue of utmost importance to both teams and fans wishing to infer a player's underlying talent or predict future performance. This is a well-studied and notoriously difficult problem. To varying degrees, leading prediction systems rely on baseball experts to isolate relevant predictive variables and combine them in logical ways. In recent years, the data science community has advocated using large datasets to train complex models rather than relying upon often-biased domain knowledge. However, applying these complex and expressive models to baseball has proven difficult due to the inherent randomness in baseball as well as the lack of abundant, clean data.

In this work, I will discuss the DeepBall projection system, a recurrent neural network that, once trained primarily on Retrosheet data, achieves performance comparable to other state-of-the-art public player prediction systems for common offensive statistics. It achieves this with minimal human guidance and domain knowledge, also overcoming the issue of limited data. Furthermore, the model is naturally extendible to other prediction tasks. We can apply standard machine learning techniques to have DeepBall model the uncertainty in its own predictions, estimating a fully defined probability distribution over potential outcomes for each player. These distributions can be studied, compared, or for simulation purposes, sampled from. DeepBall is easily coerced into predicting multiple years in the future, useful for evaluating the long-term effects of a trade. The same neural network architecture is adaptable to predict other offensive statistics or even to pitcher predictions. We believe that DeepBall can benefit both teams and fans in many ways by modeling expectation and uncertainty.

Daniel Calzada is a recent graduate of the Computer Science program (MS '18) at the University of Illinois Urbana-Champaign, where he concentrated in applied machine learning. During his time as a student, he studied making preseason batter predictions using deep learning. Daniel founded DeepBall Data (www.deepball.net) to host these predictions and has a vision to present baseball data in an intuitive, visual way for new baseball fans and an accessible way for baseball analysts. He now works full-time applying his skills to machine learning research and development in Albuquerque, New Mexico.

Diamond Dollars Case Competition

The SABR Analytics Conference is pleased to host the unique **Diamond Dollars Case Competition**. Undergraduate and graduate students from colleges and universities across the country will compete against each other by preparing an analysis and presentation of a baseball operations decision — the type of decision a team's GM and his staff is faced with over the course of a season. The case was developed by Vince Gennaro, president of SABR's Board of Directors, author of *Diamond Dollars: The Economics of Winning in Baseball*, and consultant to MLB teams. The Case Competition is the first national competition to be based solely on baseball operations issues.

Four- to five-person student teams will be asked to evaluate a baseball operations case problem. Once the student team has prepared its case, they will have the opportunity to present their analysis and recommendations to a panel of judges, which will include MLB front office executives. They will have a dialog, receive feedback and ultimately be evaluated based on the quality of their insights and analysis.

The competition will be divided into graduate/professional and undergraduate divisions. Awards will be presented to winners in each division. The competition will take place beginning at 5:00 p.m. on Friday, March 8 at the Hyatt Regency Phoenix.

Participating schools Friday, March 8

- | | |
|---|--|
| ♦ Arizona State University (Tempe, AZ) | ♦ St. John Fisher College (Rochester, NY) |
| ♦ Elon University (Elon, NC) | ♦ St. Joseph's University (Philadelphia, PA) |
| ♦ Kenyon College (Gambier, OH) | ♦ Syracuse University (Syracuse, NY) |
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(Richmond, VA) | ♦ University of Arizona (Tucson, AZ) |
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(New York, NY) | ♦ Washington State University
(Pullman, WA) |
| ♦ Oklahoma State University (Stillwater, OK) | ♦ Washington University in St. Louis
(St. Louis, MO) |

SABR Analytics Conference

Research Awards

The **SABR Analytics Conference Research Awards** recognize baseball researchers who have completed the best work of original analysis or commentary during the preceding calendar year. Winners will be announced from 11:45 a.m.-12:00 p.m. on Sunday, March 10. Here are the 2019 finalists:

Contemporary Baseball Analysis

- ♦ Wayne Boyle, Sean O'Rourke, Jeff Long, and Harry Pavlidis, "Robo Strike Zone: It's Not as Simple as You Think," *Baseball Prospectus*, January 29, 2018.
- ♦ Jonathan Judge, "The Performance Case for DRC+," *Baseball Prospectus*, December 3, 2018.
- ♦ Travis Sawchik, "Baseball Positions Are Starting to Lose Their Meaning," *FiveThirtyEight*, August 28, 2018.
- ♦ Jeff Sullivan, "Banning the Shift Is a Solution in Search of a Problem," *FanGraphs*, December 5, 2018.
- ♦ Meredith Wills, "How One Tiny Change to the Baseball May Have Led to Both the Home Run Surge and the Rise in Pitcher Blisters," *The Athletic*, June 6, 2018.

Contemporary Baseball Commentary

- ♦ Patrick Dubuque, "A Hymn for the Index Stat," *Baseball Prospectus*, December 3, 2018.
- ♦ Jeff Passan, "Here's Why Baseball's Economic System Might Be Broken," *Yahoo! Sports*, January 16, 2018.
- ♦ Sheryl Ring, "The Human Side of the Cubs' Addison Russell Decision," *FanGraphs*, December 6, 2018.
- ♦ Eno Sarris, "The Next 'Moneyball' is Already Happening All Around Us, in the Wild West of Player Development," *The Athletic*, December 7, 2018.
- ♦ Neil Weinberg, "Building Better Statistical Incentives," *The Hardball Times Annual 2018*, January 25, 2018.

Historical Analysis/Commentary

- ♦ Britni de la Cretaz, "The Hidden Queer History Behind 'A League of Their Own,'" *Narratively*, May 30, 2018.
- ♦ Steven Goldman, "Placeboball: When Baseball Proves Itself Nonessential," *The Hardball Times*, June 7, 2018.
- ♦ Ben Lindbergh, "The Sabermetric Movement's Forgotten Foremother," *The Ringer*, February 20, 2018.
- ♦ Rachael McDaniel, "Doug Ault and the Triumph of Joy," *Baseball Prospectus*, January 11, 2018.
- ♦ Dayn Perry, "The White Sox Ballpark in Chicago That Never Was and Could Have Changed History," *CBS Sports*, April 10, 2018.

Voting for the winners was conducted online at SABR.org, BaseballProspectus.com, FanGraphs.com, HardballTimes.com and BeyondtheBoxScore.com, with results weighted equally at 20%. Links to read the finalists can be found at SABR.org/analytics.

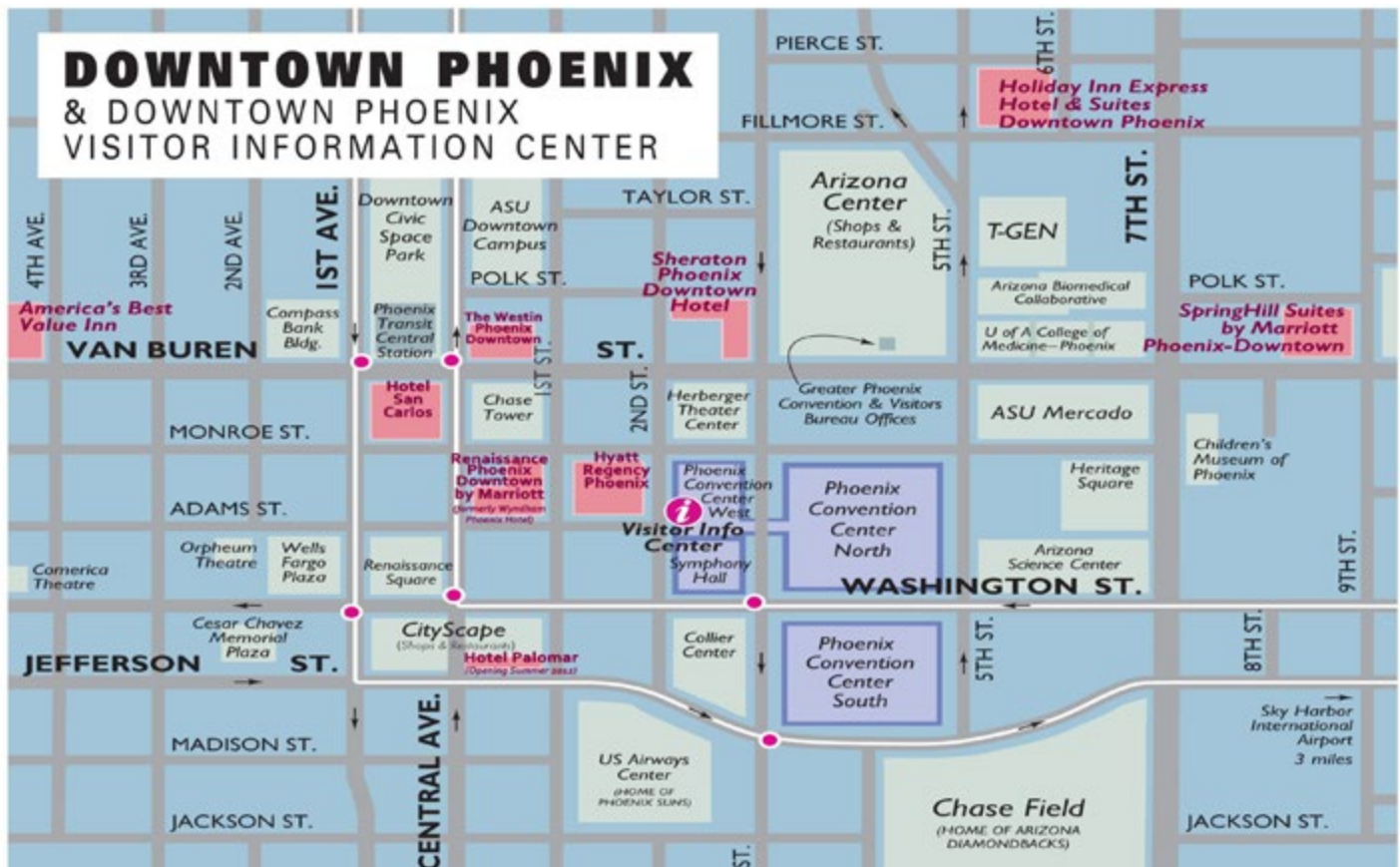
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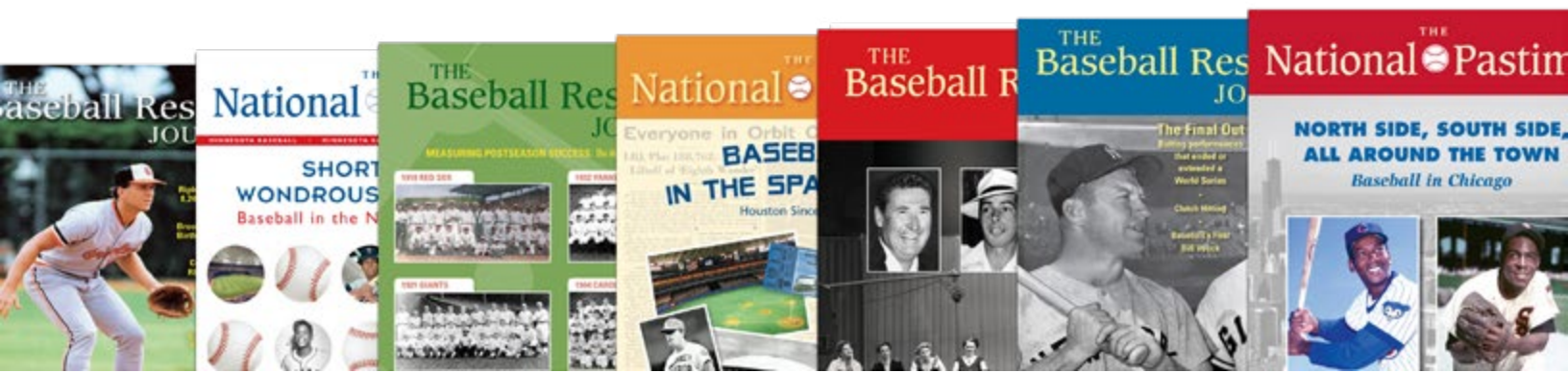


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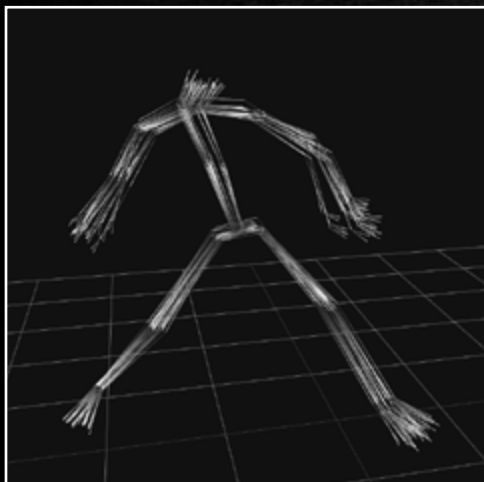
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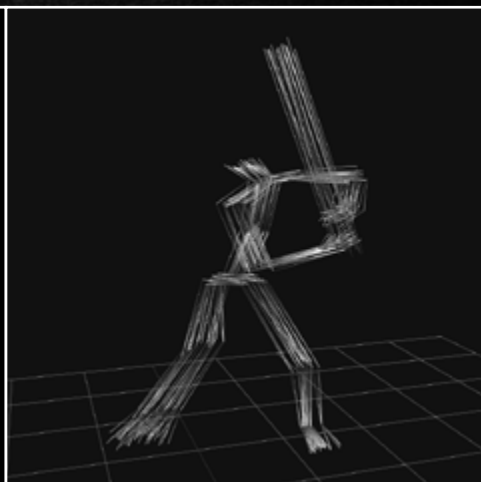
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