

NEWSLETTER

# Sports Engineering Association



# SportE



Volume. 2

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<http://sportsea.org/>

## FROM THE DESK OF CHIEF EDITOR



**Dr. Arun Kumar Jalan**

Dear Readers,

Welcome to the second issue of SportE for the year 2024, brought to you by the Sports Engineering Association (SEA). We extend our sincere appreciation to all contributors and our dedicated editorial team for making this newsletter possible.

This edition of SportE features messages from esteemed individuals, including life members of the Sports Engineering Association. Their insights and wisdom provide invaluable guidance to our community.

We are proud to spotlight the remarkable achievements and contributions of our members in various SEA activities related to sports engineering. Their dedication and hard work exemplify the spirit of our association.

Within these pages, you will find technical articles shedding light on the importance of sports engineering and sports science. These articles aim to deepen understanding and foster awareness of this dynamic field.

Another highlight is the section dedicated to students, showcasing their significant contributions and participation. By encouraging students to explore the intersection of science and sports, we aim to inspire the next generation of sports engineers.

The newsletter also introduces new members to the SEA, providing a glimpse into the future opportunities available within our association. We are committed to nurturing talent and potential, and therefore, we share information about internships, research programs, scholarships, and other avenues that can help our members advance their careers.

We invite you to enjoy reading this edition of SportE, and we value your feedback and suggestions. Your input is crucial as we strive for excellence in promoting the application of engineering in the dynamic world of sports.

Thank you for your continued support.



## Birla Institute of Technology & Science, Pilani

Hyderabad Campus

**Prof. Soumyo Mukherji**

Director



### Message

It is with great pleasure and enthusiasm that I extend my warmest welcome to each and every one of you at SEA, comprising of students and a dynamic community of scholars, researchers, athletes and sports enthusiasts. At the heart of your endeavour lies the intersection of engineering and human physiology and anatomy (embodied in sports). Research and findings in this realm where innovation, technology, and human performance converge to shape the future of athletics and the desire to reach the limit. As we delve into the domain of Sports Engineering, we find ourselves at the forefront of research and development, seeking to push the boundaries of what is possible in the world of sports.

It is my firm belief, that through collaborative efforts, relentless dedication, and unwavering passion, we can harness the power of engineering to enhance athletic performance, prevent injuries, and revolutionize the way we approach sports and fitness.

I am excited to see the incredible strides we can make in the field of Sports Engineering, particularly with respect to the application of Biomedical engineering, and I am confident that with your collective expertise and dedication, we will achieve remarkable feats that will shape the future of sports for generations to come.

Looking forward to a future filled with boundless possibilities and unparalleled achievements.

With warm regards,

Prof. Soumyo Mukherji  
Director, BITS Pilani Hyderabad Campus



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## Message from the founder Director, SEA India



Dear SEA members, friends and colleagues

We hope that the year 2024 has started well as we bid farewell to the year 2023. The end of the year also had us coming together for our 3rd International conference on sports engineering which was a huge success.

As you know that our endeavors are to connect engineering with sports, is important to have better indigenous sports facilities and technology in order to make a conducive environment for participants in sports. The application of engineering in sports has transformed the world of sports tremendously. It has enabled athletes to propel performance remarkably and redefined human potential in the field of sports. The important application areas of sports engineering are the design of sports equipment, sustainable & affordable infrastructure development, and innovative playing surfaces, which facilitate performance enhancement and injury prevention. Hence, it is important for India to invest in these areas on a priority basis in order to improve sports facilities and infrastructures indigenously at all level which will increase overall youth participation in sports.

It is, here, with great pleasure we present our 2nd issue of Vol 2 newsletter "SportE" as a quarterly publication to you. Our main goal of the SportE is to share information regarding activities of Sports Engineering Association, India (SEA) among all its stakeholders and the faculty of universities/technical institutes. Apart from this newsletter, we invite you to browse our website (<http://sportsea.org/>) which contains useful information, resources and other links.

The SEA, India introduced an incredible opportunity for students who committed to work for sports technology. We provide financial support to students for projects related to sports technology. The objective of this project is to engage students in exploring innovative technology applied in sports. We invite students to apply for the project (<http://sportsea.org/student-activities/>) or they can send their queries at <sportsengineeringindia@gmail.com>

We invite readers to send their feedback and suggestions if any about the activities of SEA, India. We also invite readers to share papers or articles related to sports technology with us. We will take our best efforts to upload them to our next issue of SportE subject to availability of space.

Please join us in our endeavors to move forward with the development activities of SEA, India.

**Dr Pintu Modak**

## TECHNICAL ARTICLE

Dear Friends,

Sports Engineering represents a unique fusion of science and engineering within the sports industry. When utilized effectively, it holds immense potential to enhance athletes' performance.

I, Chiranjibi Nayak, have dedicated over four years to my role at Qualisys, taking care of India's Sales and applications. With over a decade of experience in biomechanics, I bring a wealth of expertise to the table.

Today, I am excited to share insights into Motion Capture Analysis in Cricket, for which we at Qualisys have developed a unique analysis module specifically designed.

Best regards,

Chiranjibi Nayak

Sales & Application Manager in India, Qualisys

[qualisys.com](https://qualisys.com), [chiranjibi.nayak@qualisys.com](mailto:chiranjibi.nayak@qualisys.com)

### Qualisys 3D Cricket Analysis

Combine our motion capture technology with a unique cricket analysis package to assess bowling and batting presented as a web report, enabling players and coaches alike to view and share data results.

Qualisys' Cricket Analysis can be used to study different aspects of the game such as batting and bowling. By analyzing a player's movements in detail, coaches and players gain valuable insights into their technique, which can help them make adjustments to improve performance and reduce the risk of injury.

Our module guides you through data collection and connects Qualisys Track Manager (QTM) directly with the Calculus online processing engine to immediately produce a report analyzing the player's form in 3D. Both the bowling and batting movements have been developed using references from global publications of cricket biomechanical analysis.



**Chiranjibi Nayak** BPT, MBA  
sales & Application Manager



Scan to preview

#### FEATURES

- All relevant biomechanical variables
- Sports Marker Set for full-body analysis
- Easy data management
- Support for bowling and batting analysis
- Interactive Web Report
- Capture outdoors
- Open source calculations
- Cloud-based reprocessing
- Servers are compliant to major security frameworks (ISO 27001, HIPAA, GDPR)

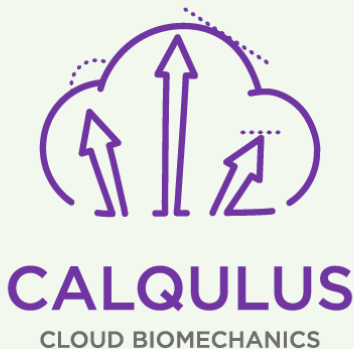
## Process

Reflective markers are placed on the athlete according to an anatomical guide that is included with the module. A pre-defined marker sets - the Sports Marker Set - is included when the Calculus module is installed so you can get started right away. Recordings are made through a guided panel in the QTM software, making data collection quick and easy.

## Report

With the click of a button, Calculus processes the data in the cloud, biomechanical calculations are performed, and an online report is automatically generated. The end report includes variables such as stride length, pelvis-shoulder separation, elbow flexion, wrist cocking angle, and others.

Interact with your report, annotate the charts for athlete feedback, and share it via link or PDF download. Learn more about the Qualisys Web Report platform by visiting the Qualisys [website](#).



## Streamline your mocap data processing

Rather than relying on external software to process your data, the Calculus engine performs all of the calculations in the cloud. Your processed data can then be viewed and shared from the online report center.

Calculus is a one-stop-shop for all your desired sport analyses bundled into a single module, including sports such as Running, Cycling, Baseball and Cricket. With Calculus, you can easily and quickly reprocess your data right in the cloud whenever you need it and wherever you are.

## Analysis options and requirements

| Module Session  | Marker set                 | Cameras (min) | Room size (min) | Processing engine | Report |
|-----------------|----------------------------|---------------|-----------------|-------------------|--------|
| Cricket-Batting | Qualisys Sports Marker set | 8-10          | 4 x 6 m         | CALQULUS          | Web    |
| Cricket-Bowling | Qualisys Sports Marker set | 10-12         | 4 x 10 m        | CALQULUS          | Web    |

## TECHNICAL ARTICLE

### The Prospect of Intelligent Sport in India



**Manish Meena**

**Master's Student, IIT Gandhinagar**

In the dynamic landscape of sports, India is experiencing a transformative wave propelled by the integration of cutting-edge technologies, ushering in the era of Smart Sports. This paradigm shift is not only evident in professional sports but also permeates grassroots levels, with both government and private organizations actively championing the cause of sports wearable Technologies.

The synergy between technology and sports is catalyzing a revolution in performance enhancement across various disciplines. Notably, in cricket and table tennis, the advent of intelligent bowling machines and smart stadiums equipped with state-of-the-art resources has redefined the boundaries of athletic achievement. For instance, in cricket, the introduction of AI-powered bowling machines allows players to practice against simulated match scenarios, refining their skills against diverse playing styles. Similarly, smart stadiums like the one in Ahmedabad, Bengaluru, and many others equipped with cutting-edge technology enhance the spectator experience through interactive displays, real-time analytics, and augmented reality features during the IPL and International Games.

The arsenal of technologies, including speed analyzers and data collection tools, leverages artificial intelligence, big data, and cloud computing to streamline record-keeping and facilitate in-depth analysis. A notable example is the use of Hawk-Eye technology in cricket, which employs multiple camera angles and complex algorithms to track the trajectory of the ball, providing precise insights into decisions such as LBW (Leg Before Wicket) calls.

Smart sport in India is not merely a technological leap; it represents a major developmental stride. The combination of hardware and software, leveraging advanced scientific and technological tools such as big artificial intelligence, data processing, cloud computing, embedded technology, and sensor technology, is changing the complete face of the sports ecosystem. This transformation ensures that fitness programs are more planned, targeted, and scientifically grounded. For instance, wearable fitness trackers and smart equipment, like Fitbit and Peloton, use data analytics to personalize workout routines, track progress, and offer real-time feedback, democratizing access to personalized fitness experiences. Beyond individual fitness, there is a growing influx of social capital into the sports industry, with numerous internet enterprises contributing to the amalgamation of modern sports.

Mobile internet technology is increasingly being used for health and competition performances, showcasing the broader societal impact of smart sports initiatives. Initiatives like online fitness challenges, fitness apps, and virtual sports competitions have not only engaged the masses but have also redefined the accessibility and inclusivity of sports participation.

Moreover, the construction of smart stadiums at universities is emblematic of a proactive approach toward understanding and exploring technological advancements in the sports domain. This not only elevates the standard of sports infrastructure but also serves as a hub for innovation and experimentation, fostering a culture of continuous improvement in sports technology. The Jawaharlal Nehru Stadium in New Delhi stands as a testament to this commitment, incorporating sustainable practices and state-of-the-art technology to host international events while minimizing environmental impact. As India strides confidently into the realm of smart sports, the convergence of technology and athleticism promises a future where performance, accessibility, and health are intricately interwoven, paving the way for a new era in Indian sports that is both technologically advanced and socially inclusive.

The emergence of smart sports in India signifies an important shift in a variety of fields, not simply technology. The potential for smart sports in India is wide, ranging from the incorporation of AI-driven equipment in sports training to the use of motion capture technology to improve the spectator experience during events such as the TATA IPL 2023. This technological infusion is not just affecting professional sports but is also affecting grassroots levels, enhancing athlete performance and redefining how sports are experienced. The impact of smart sports is broad, encompassing athlete performance enhancement via digital intelligence, the rise of wearables capturing vital data to prevent injuries and tailor training regimens, and the evolution of immersive experiences for global audiences via augmented reality, virtual reality, and enhanced remote viewing experiences.



## TECHNICAL ARTICLE

### Ball Trajectories in Sports and Predicting Them



**Pasunuru Sai Vineeth**

**PhD Student, IIT Madras**

Sport stands as the world's most widely embraced form of entertainment, whether one is an active participant or a spectator. Despite their distinctiveness, popular sports such as football, tennis, baseball, basketball, and cricket share a commonality. They all involve dynamic interaction with a playing ball. This interaction varies across sports; players may employ equipment like racquets (as seen in tennis, table tennis, and badminton) or bats (featured in baseball and cricket) to hit the ball, use their feet to kick the ball (as in football) or opt for throwing it (as in basketball). Furthermore, some sports allow the ball to bounce on the playing surface, extending the sequence of play (e.g., cricket and tennis), while others conclude the point immediately upon contact with the ground or court (e.g., volleyball and badminton). If we can understand how the ball interacts with the air in flight and responds to the playing surface upon bounce, the trajectory of the ball makes intuitive sense.

In high school, we all have studied that a projectile in air is acted upon by a constant gravitational force which points downwards. The object thus moves with a uniform velocity in the horizontal direction and a uniform acceleration in vertical direction. Hence, it takes a parabolic path for which the quantities like time of flight, range and maximum height can be analytically computed. But this is an idealization that works precisely only in vacuum. For an actual flight of a ball in air, additional forces come into play due to the ball's interaction with the surrounding air. The air resists the relative motion of the ball thus slowing it down with time and shortening the trajectory. This opposing force is called drag and it acts anti-parallel to the ball's instantaneous velocity vector. In addition, if the ball also has spin, it undergoes further deviation from the projected path that is already affected by the drag. This is generally termed as Magnus force or lift, even if it has a downward component. Unlike the drag force, this lift force acts perpendicular to the instantaneous velocity vector. The sum of these three forces is the net force experienced by the ball in flight, at any moment.

But, the amount of deviation from the parabolic path depends on the ball in interest. In sports like shot put or basketball, the ball is very heavy. Thus, gravitational force dominates the aerodynamic forces i.e. drag and lift, which makes the trajectory near-parabolic. In other extreme, there are tennis and table tennis where the aerodynamic forces exceed the gravitational force. These balls deviate the most from parabola. In most of the other balls, these set of forces are

comparable. The shuttlecock used in badminton has one of the most unique trajectories in sports. The drag on the shuttlecock is usually two orders of magnitude higher than the gravitational force.

This initially lets the shuttlecock take a straight trajectory where the velocity keeps exponentially decreasing. The reducing velocity keeps decreasing the drag and eventually the drag becomes similar in magnitude to gravitational force, making the shuttlecock drop vertically downwards at a constant (terminal) velocity. No part of this trajectory is parabolic and it is named a Tartaglia Curve, after the scientist who first reported it.

When a sports ball finishes its journey in the air and hits the ground, it may undergo actions like sliding, rolling, gripping or a combination of them before leaving the ground. The type of interaction during the short impact duration modifies the spin and velocity of the ball accordingly which will determine the way the ball is going to rise up. The ball can also get compressed during the impact because of the vertical component of incoming velocity. In some sports like tennis, the ball deforms greatly on contact with ground and some energy will be lost as it rebounds while a portion of the remaining energy continues to reduce in the flight because of the surface perturbations. Whereas fairly rigid balls like a cricket ball stay mostly unaffected during the impact thus minimizing the energy loss. There are various existing theories to model the bounce of a ball. They include utilizing the coefficient of restitution and/or the coefficient of friction between the ball and the surface. Once, the ball rises up from the playing surface, it re-enters the flight regime.

The trajectory of the ball can be quantified for any desired duration using the flight and appropriate bounce models. This entails acquiring the initial conditions of flight (i.e. position, velocity and spin) in addition to understanding the characteristics of playing surface. The net force in flight per unit mass gives acceleration the ball experiences at every time step and with successive integration, the instantaneous velocity and position of the ball can be derived. The bounce model takes in the kinematic parameters (velocity and spin) right before the bounce, which are derived from the flight model, and produces the kinematic parameters immediately after the bounce.

The capacity to calculate a ball's trajectory finds practical utility in various domains, and one notable application is in enhancing the precision of LBW (Leg Before Wicket) decisions in cricket. In this context, only a segment of the trajectory, specifically up to the point where the ball makes contact with the batsman, is directly observable. To fully comprehend the trajectory beyond this point, a meticulous modeling process is essential to extract the initial conditions from the available data. This will play a crucial role in accurately constructing the flight of the ball until it reaches its final destination on the pitch. This process is instrumental in providing cricket officials and decision-makers with valuable insights to make informed LBW decisions based on a thorough understanding of the ball's complete trajectory.

## OUR ASSOCIATES and SPONSORS

1. International Sports Engineering Association (ISEA), England
2. Ministry of Youth Affairs & Sports, New Delhi, India
3. Shiv Naresh Sports Pvt Ltd
4. SporTech Innovation Lab Pvt Ltd, Pune, India

## UNVEILING OF FOURTH NEWSLETTER



Volume 2 Issue 1 newsletter of SEA "Sport-E" unveiled by Dr. PC Panchariya, Director CSIR-CEERI Pilani, on 4th December 2024.

## NEW MEMBERS, LIFE TIME, SEA



L/2024/14/01/10061  
Prof. Ajita D Singh  
Director, Sports  
Punjabi University, Patiala (Pb) India

## NEW MEMBERS, ANNUAL MEMBER, SEA



A/2024/02/25/10034  
Mr. P. Sudhan Ponnappan  
Teaching Faculty, Physical Education  
SRM Institute of Science and Technology, Chennai India

## STUDENT PROJECT SCHEME

### Project financial support

We encourage students from engineering and science disciplines to actively participate in various activities such as product design, movement analysis, app development, and software development. To support their involvement, we are announcing a cash support program. All student members are eligible to apply, and the application process is open throughout the year. To apply, please submit a one-page summary of your project along with your student membership number to [sportsengineeringindia@gmail.com](mailto:sportsengineeringindia@gmail.com).

Additionally, SEA (Sports Engineering Association) provides funding opportunities to student members for undertaking small projects in sports technology. We also strive to offer them a nationwide platform to showcase their development work through newsletters and conferences.

### Student Project Scheme

The Student Project Scheme is a core element of our commitment to fostering innovation and research in sports technology. The scheme is aimed at encouraging individual student members or groups to delve into innovative technology applications within the sports domain.

#### Key Features of the Scheme:

- **Financial Support:** Students can apply for funding of up to Rs. 10,000 to facilitate their research projects or the development of prototypes, models, or products.
- **Duration:** Projects under this scheme should be completed within a six-month timeframe, allowing students to channel their efforts efficiently.
- **Application Procedure:** The detailed application procedure, including eligibility criteria and submission guidelines, can be accessed on the SEA website: <http://sportsea.org>. We encourage all full-time undergraduate or postgraduate students in engineering, science, or sports science to consider joining SEA as student members to avail themselves of these exciting opportunities.

### Showcasing Development Work

SEA recognizes the importance of providing a platform for students to showcase their projects and findings. We facilitate this through newsletters and conferences, ensuring that their efforts gain visibility at a national level.

Embrace this opportunity to turn your innovative ideas into reality with the support of SEA's Student Project Scheme. We are dedicated to nurturing the next generation of sports engineers and scientists, driving advancements that will shape the future of sports technology. Join us in this exciting journey of exploration and innovation!

# SPORTS INFRASTRUCTURE SPECIALISTS



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- Jain International School
- Salt Lake Stadium
- Delhi Public School
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Indian  
SPORTS  
Room



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## EDITORIAL TEAM

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**Manish Meena**  
**Master's Student**  
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Gandhinagar, Gujarat, India



## INVITATION FOR SEA MEMBERSHIP

### Contact:

We invite you to join us and become a member of the SEA family. Your expertise is important for us to take the mission of SEA forward.

**Membership Link:** <http://sportsea.org/joining-payment-process/>

### Opportunities/ Benefits of joining the SEA as Member:

- Receive a Membership Certificate, inclusion of profile in Membership Gallery, discount on Conference registration charges
- Opportunity to utilize the collaborative platform to interact with Domain experts and other members of SEA
- Discount on conferences, workshops and any other professional development events organized by SEA
- Student members may get an opportunity to work in research projects
- Receive periodicals / newsletter, publish articles in periodicals & newsletters
- Receive award / recognition for innovative contribution to the technology development Attend board meetings (only for life members)
- Opportunity to open State Chapter (only for life members)
- \* (A full-time student at any time during her/his period of study can join SEA as Student Member through a onetime payment of token membership fee. Student members are eligible to get Rs 10,000/- as grant for innovative project development. On completion of course, he/she will cease to be a Student Members but are encouraged to make fresh application for Life membership of SEA remitting the full life membership fee.)

### Sports Engineering Association

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