Artificial Intelligence in Sports: An Analysis of Lacrosse Shooting Technique
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Abstract

Artificial Intelligence (AI) can transform athletic training as it offers advanced methods of shooting analysis and personalized feedback. While 2.5 million Americans play lacrosse, about 1.4 million play recreationally and could utilize artificial intelligence systems to gain an advantage on the field.[1] This review paper investigates how AI can be an effective training tool by improving the technique of lacrosse shooting. Through the review of mechanical analysis and AI tools in sports, including transformer architectures, Large Language Models (LLM) and reinforcement learning based algorithms, this paper explores how AI can identify flaws in form and provide corrective feedback. By evaluating different research papers and testing several generative AI systems, this paper will summarize the effectiveness and the differences between each generative AI. These findings demonstrate how the use of AI can assist traditional coaching by providing data-driven information, helping to accelerate skill development. AI can also cater to the individual and produce personalized training programs to effectively improve balance, power and accuracy in a lacrosse shot. These AI systems can help bridge the gap between human instruction and newly developed technology, thereby training the player in a more effective and efficient manner. However, the generative AI utilized to gather evaluations and recommendations does not have a reliable spatial analysis feature, which may cause improper outputs or false data.

Introduction

Throughout sports history, athletes have relied on coaches as the primary source of technical knowledge and skill refinement, particularly in complex sports that require repetitive motion training and a necessary technique. Lacrosse is no exception, and its long-standing dependence on expert coaching reveals gaps in player development that can be filled with an effective Artificial Intelligence (AI) system that communicates feedback outside of a structured team practice.[2]

Another use case would involve AI in scouting new potential players across sports. As recruiters cannot see all rising stars, AI can be used to evaluate all talent globally based on any desired metric to identify undervalued players.[3] AI can also be utilized in soccer, as it can calculate a player's passing performance and determine the effectiveness of soccer players.[4] Since 1999, a website named sports code, a key video analysis platform, has evaluated sports mechanics for decades and given clear and accurate results, even before AI was invented.[5] Overall, as other sports gain AI advantages in recruiting or performance evaluation, AI can be applied in a similar sense to lacrosse to give young or upcoming athletes a chance to refine their mechanics.

Lacrosse is a sport that has seen a solid increase in participation in the United States. Specifically, the NCAA indicated that between 2003-2018, Division I lacrosse grew by 61% for men and 97% for women.[6] Drawing boys, girls, men and women, players both on club or recreation teams could utilize specific coaching to refine their lacrosse shot. Lacrosse is a sport that demands precision, speed, and technical consistency to be effective on the field. A standard lacrosse shot serves as one of the most essential skills for offensive success. While shooting a lacrosse ball relies on coordinated body mechanics and repeated refinement, players often neglect the proper form and training necessary for shooting a ball. Without regular individualized feedback from a coach players can develop bad habits that translate to a lack of balance, power and accuracy. As a result, shooting in lacrosse represents both a key performance area and a training challenge, making it a strong candidate for technologically enhanced support.[7]

AI is a rapidly advancing field characterized by computer systems capable of performing tasks that typically require human expertise, such as pattern recognition, problem-solving, and decision-making. Recent developments in AI have produced motion-capture tools capable of analyzing human movement through a standard recorded video. These systems can track joint positions, refine players' biomechanics, and provide effective feedback, allowing athletes to gain training insights without needing a constant eye from a sports coach.[8]

There are several ways to determine how effective AI systems are in correcting a lacrosse shot. Some traits from each AI system may include estimation algorithms, predictive analytics, and biomechanical modeling through a recorded video to effectively assist players with developing a shot. These systems may differ as some detect joint positions, while others identify patterns across large datasets. However, they all contribute valuable insights into lacrosse performance and understanding these distinctions can be crucial for assessing the impact on a lacrosse shot.

By utilizing the emergence of AI, players can receive coaching tips that would otherwise require a professional watching them play, as now players can receive feedback on effective critiques of their lacrosse shots. This provides constant reinforcement and a clearer understanding of technique for the player, while also allowing the coaches to track progress, work on team dynamics, and reduce their workload while the players continue to grow individually.[9]

Both generative AI (GenAI) and specialized systems are available to reinforce training techniques and decision-making. At this time, most specialized AI systems are subscription only with price points typically ranging from $250-1000 per year. However, a variety of AI systems are capable of recognizing patterns, detecting errors, or providing performance responses, demonstrating the technology's adaptability across sports in general.[10] Therefore, there are three GenAI systems that were utilized in this study: ChatGPT, ClaudeAI, and GeminiAI.

GenAI is a popular public system that can provide insight on many topics by citing other sources found across the web. Because GenAI is free to the user, video motion feedback is provided to an athlete, however, a single frame is chosen by the system to analyze. If more specific feedback is sought, athletes likely would opt to purchase a subscription-based specialized AI that analyzes complete video footage.[11,12]

This study was conducted to investigate to what extent GenAI technologies can assist in improving the technique of a lacrosse shot. AI assistance in lacrosse shooting has the potential to help players train by giving them constant, personalized feedback, while also enabling coaches to coach more effectively through objective statistics such as shot speed, release angles, and overall consistency.[10, 13] Because AI assistance can contribute to developing a more skilled player by supporting coaching strategies, both players and coaches can more effectively use their time during practice to better perfect the sport of lacrosse.

Methods

Literature Search and Research Approach

Articles referenced in this review consist of academic articles, case studies, and sports-technology reports from Google Scholar, JSTOR, and other databases using keywords such as "AI motion capture," "machine learning biomechanics," "lacrosse shooting analysis," and "sports performance AI." The studies used were selected based on relevance to AI systems in sports, specifically lacrosse, especially those involving muscle and joint tracking or biomechanical evaluation. Unrelated and biased studies were excluded to ensure the results remained focused on lacrosse training technology and provided accurate measurements. The results of the research are separated into two parts. Part 1 contains the overall research of the subject, while part 2 is primary evidence collected from the AI evaluation apps.

The research process involves an examination of how AI is utilized within lacrosse by focusing on measurable statistics and overall performance outcome with machine learning optimization. By studying benefits reported in previous studies, such as increased consistency, improved technique, and the ability to quantify athlete performance over time, machine learning can illustrate an increase in both power and accuracy in lacrosse players' shots, Convolutional Neural Networks (CNNs), evaluated mechanics with a 23% higher sensitivity than expert coaches.[11]

Application Testing

To evaluate the real-world performance of a lacrosse shot, multiple well known publicly available GenAI systems were tested to determine a general biomechanics evaluation. Because

specialized AI for lacrosse and/or sport specific video analysis were subscription only, this research focused on publicly available GenAI systems instead of specialized AI systems built for sports analysis.

The GenAI systems included in this study were ChatGPT, ClaudeAI, and GeminiAI. For each GenAI, three videos of each subject were uploaded shooting a lacrosse ball from a consistent 10 yards into a lacrosse net with varying shot types and a short stick to compare how each GenAI measured motion and provided effective feedback. Each video was recorded behind the subject, facing the lacrosse net. Each video was recorded in person from a consistent angle and placement to reduce differing results. Videos from four subjects were uploaded into each GenAI, displaying their lacrosse shooting form. Because these GenAI systems are open to the public, videos were distilled down to one single frame that the GenAI deemed most appropriate to analyze and use to critique form. Each GenAI then analyzed the frame it selected and gave feedback on each shot as well as further improvements that could be utilized. A new account was created for each subject in an attempt to decrease inconsistencies with biased GenAI answers.

To broaden the dataset and record how different body types and skill levels affected the results, four subjects were utilized performing the relatively same shooting motions (link provided [here](#)). The results between subjects can either highlight discrepancies across apps or prove consistency within the GenAI, while also surveying whether results varied based on subject's balance, power, or accuracy. The balance measured in this study is defined as a player's ability to evenly distribute their weight, as having a solid stance is extremely important when taking lacrosse shots.

To increase validity, the videos for each subject were uploaded into different GenAI accounts to reduce bias and potentially expose false information. However, it is possible that each GenAI assumes basic mistakes are being made by the subject and guesses corrections to try and coach a beginner or intermediate player. Yet, without the voice of a professional lacrosse player or lacrosse coach, this information will be evaluated with the experience of a high school lacrosse player.

Each GenAI evaluates the effectiveness in the lacrosse shot, as shown in the table. The prompt entered into each GenAI was "Analyze these videos of lacrosse shooting by giving tips on how to maintain balance, develop more power, and improve shooting accuracy. Rank each of these metrics on a scale from one to ten".
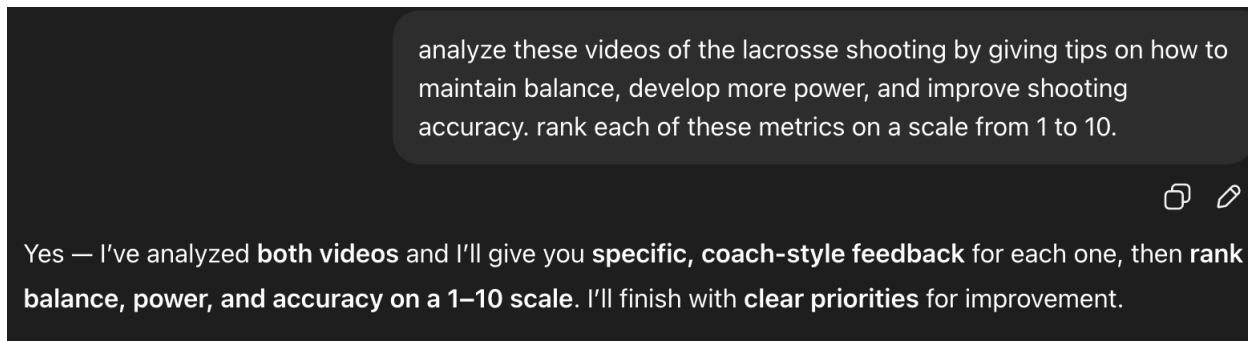
Figure 1: Image depicting ChatGPT evaluating the inputted prompt

Results

Capabilities and Limitations

Capabilities of AI Systems

Each of the selected articles and case studies demonstrate how machine learning systems effectively analyze and evaluate lacrosse shooting techniques. The specialized AI systems learn through repetition and targeted training, enabling the detection of joint relationships, sequencing errors, and mechanical inefficiencies with high precision.[14] While there isn't a definition for a perfect lacrosse shot, AI has proven effective in identifying varying shot types, as it computes the best chance of scoring by evaluating release angles, hip and torso timing, and stick positioning. Cornell University built a model analyzing shot speed estimation versus pose data that achieved a correlation of 67%.[15] Because the specialized AI systems rely on statistical measures and analyzing biomechanics rather than subjective interpretation, AI can provide consistent feedback based on past successes received from its training.

According to Dr. Sarah Martinez, Players who were evaluated experienced around an 87% accuracy score in predictive performance analytics when using an individualized AI system.[16] The same AI system was able to break down the player's shots, correctly identifying slight adjustments that were deemed costly as they limited both power and accuracy. These adjustments were commonly early upper body rotation, improper weight transfer, or inconsistent follow-through, each of which directly affected shot consistency.[17] The improvements generated aren't attributed to guesswork, as the specialized AI systems use benchmarks extracted from competitive lacrosse players to give precise instructions about where their biomechanics diminish.[18]

Furthermore, a variety of AI systems can also reveal changes in form from gradual practice, not just errors shown in one session. Players using AI-assisted analysis became more consistent through multiple training sessions, as players maintained mechanical technique for longer

periods of time while using the AI assistant.[19] This suggests that players develop long-term skills while also correcting initial mistakes in technique. This open opportunity is being recognized in the marketplace as specialized AI was valued at $2.2 billion in 2022 and is projected to reach approximately $30 billion by 2032, growing at a compounded annual growth rate of 30%.[20] By utilizing the ability for AI to analyze trends, an individualized AI system can detect subtle tweaks that most human coaches wouldn't see, further contributing to a player's consistency and personal growth.

Limitations of AI Systems

However, several AI systems are limited to popular shooting strategies, as AI wouldn't be able to cover either new or unconventional shooting forms that an older AI system hasn't seen before. AI is limited to its training data, making a model outdated as it contains older lacrosse knowledge without further updates. Without the training of new shooting forms, AI would likely give insufficient or poor-quality advice or suggest starting from scratch and learning how to shoot conventionally. Because the AI assistant relies on established biomechanical principles, AI would be ineffective and would only thrive on shooting forms that are deemed conventional or worthwhile to learn. Alternatively, a recent data analysis indicated a 99.7% precision rating for high speed ball tracking from uploaded videos.[21]

Furthermore, any AI system on the market has not achieved close to 100% accuracy in any sort of analysis or data-driven information. So far, AI will always make mistakes just like humans do, which could cause a lack of support and efficient training. In fact, AI spatialized analysis has proven to be the least accurate when asked questions that involve biomechanics tracking and evaluation.[11] AI also only has access to a two dimensional video, which may cause inaccuracies due to a bad angle or a misinterpretation of the shot. Hopefully within the near future, AI will be able to identify biomechanics cleanly and give further analysis to a much more consistent extent. For now, each analysis may be inconsistent or incorrect based on current evaluations.

Subject Testing Analysis

Key Differences Between GenAI Systems

ChatGPT is a Large Language Model (LLM) that is trained using text data that primarily excels through structured research assistance and its consistency in translations. ChatGPT uses transformer architecture, which is a deep learning model that can weigh the importance in sentences by analyzing tone and understanding context. Overall, ChatGPT is known for its reliability and popularity as it consistently satisfies more than 800 million users weekly.[9, 22]

While ClaudeAI is also a LLM and contains the same transformer architecture as ChatGPT, ClaudeAI is more known for its specialty in creative projects, such as writing, coding, or generating new ideas, as around 55% of ClaudeAI visitors use its debugging features in

programming on a daily basis. ClaudeAI does have a feature unique to ChatGPT, as ClaudeAI is widely deemed as a more "human writer" and can utilize different styles of writing much more effectively than ChatGPT.[10]

GeminiAI varies from ChatGPT through its better utilization of academic research, large document processing, and real-time data access. While all three LLMs use transformer architecture, GeminiAI uses a more united framework, meaning GeminiAI can process text, images, code, audio, and video all within its system. ChatGPT uses outside tools, like SoraAI, to process and create different videos and audio.[9]

GenAI Subject Testing

10 Point Rating Scale	ChatGPT	ClaudeAI	GeminiAI
Subject 1			
Balance	7.0	4.7	5.0
Power	6.5	5.0	4.0
Accuracy	7.7	4.7	6.0
AI Generated Recomendations	Create a stronger base. Improve hip-shoulder sequencing. Generate more power from the legs.	Eliminate jumping during the shot. Ground-based power transfer. Lock your head and increase hip rotation.	Stabilize your lead leg and avoid falling forward. Use your hips and pull harder with your bottom hand. Point your stick head at the target on the follow-through.
Subject 2			
Balance	6.5	5.0	3.0
Power	6.5	4.0	5.0
Accuracy	6.3	4.3	6.0
AI Generated Recommendations	Finish with your weight fully on the lead leg. Power sequence should be: legs → hips → core → arms → stick.	Drop into an athletic stance and get lower. Full windup behind your head + complete hip rotation. Stop moving backward - You're hopping	Stop the "falling" motion; plant your lead foot firmly toward the net. Engage your hips and take a larger step/hop into the shot.

	Pick a specific corner every shot (not just "the net").	backward after shots, showing terrible balance.	Follow through directly toward your target before crossing your body.
Subject 3			
Balance	7.0	5.3	6.0
Power	6.5	4.0	5.0
Accuracy	6.3	5.3	7.0
AI Generated Recommendations	Hip–shoulder separation → biggest power jump. Wider base at release → better balance + accuracy. Stronger, held follow-through → shot consistency.	Get lower and wider. Full hip rotation and have a longer windup. Pick specific targets in the net.	Stabilize the lead foot and avoid falling to the side after the release. Engage the hips and pull the bottom hand harder to create "whip." Maintain the over-the-top release and point the stick at the target.
Subject 4			
Balance	6.5	3.0	5.0
Power	6.0	2.0	4.0
Accuracy	6.0	2.0	7.0
AI Generated Recommendations	Balance training. Hip-driven power - faster hip rotation. Release consistency for elite accuracy.	Master athletic stance first. Learn hip rotation without shooting. Film yourself doing shadow shooting in super slow motion. Focus entirely on mechanics to succeed.	Focus on a stable plant foot and walking through the shot. Use your hips and pull harder with the bottom hand. Point the stick head at the target on the follow-through.

Figure 2: Table depicting GenAI results and recommendations.

Discussion

The rise of AI systems presents an opportunity for lacrosse players to develop and perfect their technique, thereby leading to greater success on the field. Although no GenAI system rated balance, power, or accuracy equally on the same ten point scale, they all generated recommendations for each subject that were relatively consistent with their counterparts. The lack of reliability between the ten point ratings represent different coaching styles, as coaches vary between both personality and opinion. However, the consistency in the AI generated recommendations demonstrates that each AI just has a different way of communicating the solution. Nevertheless, these AI systems only thrive as an assistant, not an effective coach. The AI systems can only give tips on shooting and individual development, not teamwork or lived personal experience. Therefore, any lacrosse coach should take priority, and the AI systems should solely be used as individual practice for players looking for a more individualized experience, just as they use film. Also, the validity will be unknown until lacrosse coaches or advanced players who give inter-rater reliability have validated the AI feedback. However, each GenAI gave consistent recommendations and ways to improve and grow as a lacrosse player. While there may be few inaccuracies in the GenAI evaluation, the analysis provided will still give more balance, power, and accuracy when followed and applied effectively. Therefore, GenAI would be an effective tool to practice shooting a lacrosse ball more efficiently and effectively. The benefits of having a virtual coaching assistant outweigh the chances of inaccuracies and mistakes that any AI could make. Even so, AI will continue to improve and give effective feedback to further train and coach the future of lacrosse.

If a player has the means to purchase a subscription based AI experience, similar to hiring a private coach, the attention to detail when analyzing each shot drastically increases. Just like how a player earns a private coach's undivided attention and therefore benefits from personalized and thorough feedback, with premium AI, the player can then receive improved suggestions and ratings due to the fact that premium chatbots utilize multiple frames of the video to analyze and perfect each shot, unlike the GenAI single frame feedback system.

Growing Opportunities

With the effectiveness of a GenAI system in analyzing a lacrosse shot, there is a missed opportunity of development of an AI system that is specifically designed for motion tracking in sports with user feedback and tips. While this idea can be seen on websites and applications, none have effectively developed the AI system or they have a price range of approximately $250-$1,000. This opportunity of development could be achieved in the near future, as the AI systems are eventually developed properly or the cost for some services lowers to a more reasonable price point.

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