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(54) **ATHLETE REACTION TRAINING SYSTEM**

Publication Classification

(75) Inventor: **Thomas Clark Hawkins,**
Marblehead, MA (US)

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(57) **ABSTRACT**

Correspondence Address:
THOMAS CLARK HAWKINS
132 BEACON STREET
MARBLEHEAD, MA 01945

What is new in this invention is the capability to reproducibly measure athlete's reaction times and virtual save/intercepts to actual competition intercept positions, using a computer display of simulated sports projectiles and their direction, and contact, magnetic, or light triggered position detectors in actual athlete intercept positions, using their own equipment, and incorporating the critical first step. Also new is software to calculate the reaction time and virtual save/intercept from a visual cue to the appropriate intercept position, and real time reporting of the reaction times permitting real time adjustments, in reproducible ways has not been available for sports other than track and swimming. The training system enabled by this new invention consists of sessions of prescribed, measurable reaction training for athletes—which has not been previously available—random and sequence sessions for positioning, reaction time, and virtual save/intercept, with reporting allowing standardized reaction time comparisons over time and between athletes.

(73) Assignee: **Thomas Clark Hawkins,**
Marblehead, MA (US)

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Related U.S. Application Data

(60) Provisional application No. 60/863,345, filed on Oct. 27, 2006.

System Layout Option 1: Athlete Position Detectors/Contact on the Athlete's Frame of Reference

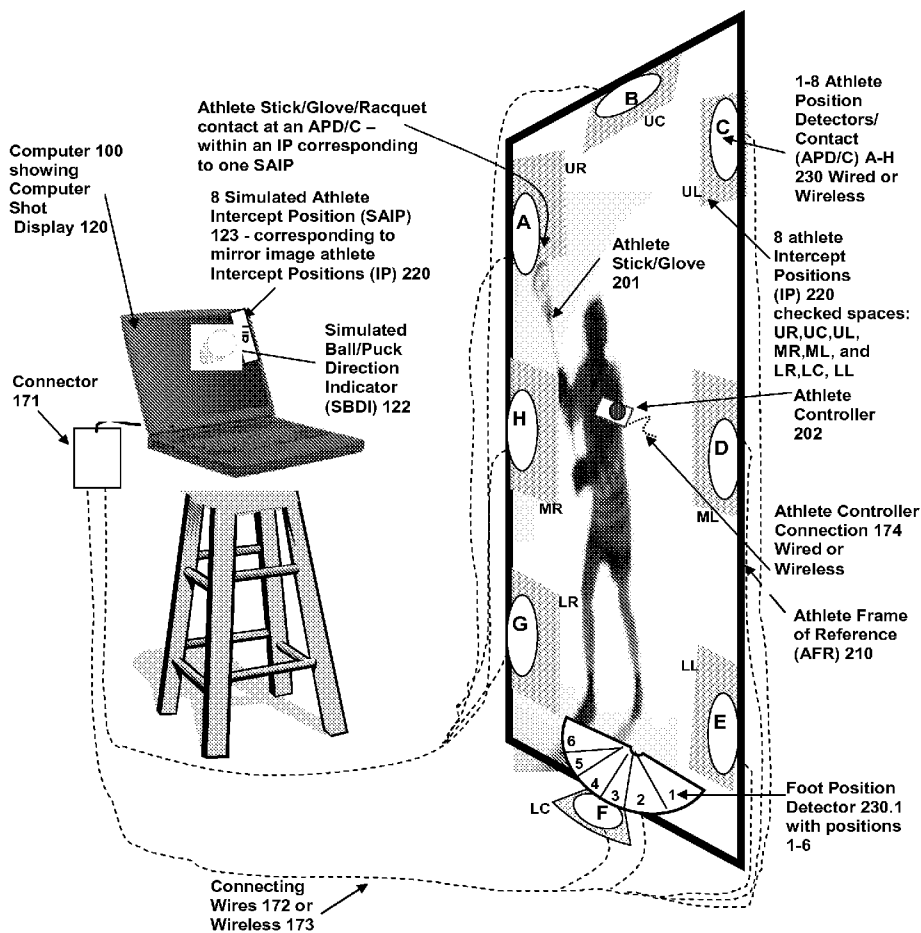


FIG. 1: System Layout Option 1: Athlete Position Detectors/Contact on the Athlete's Frame of Reference

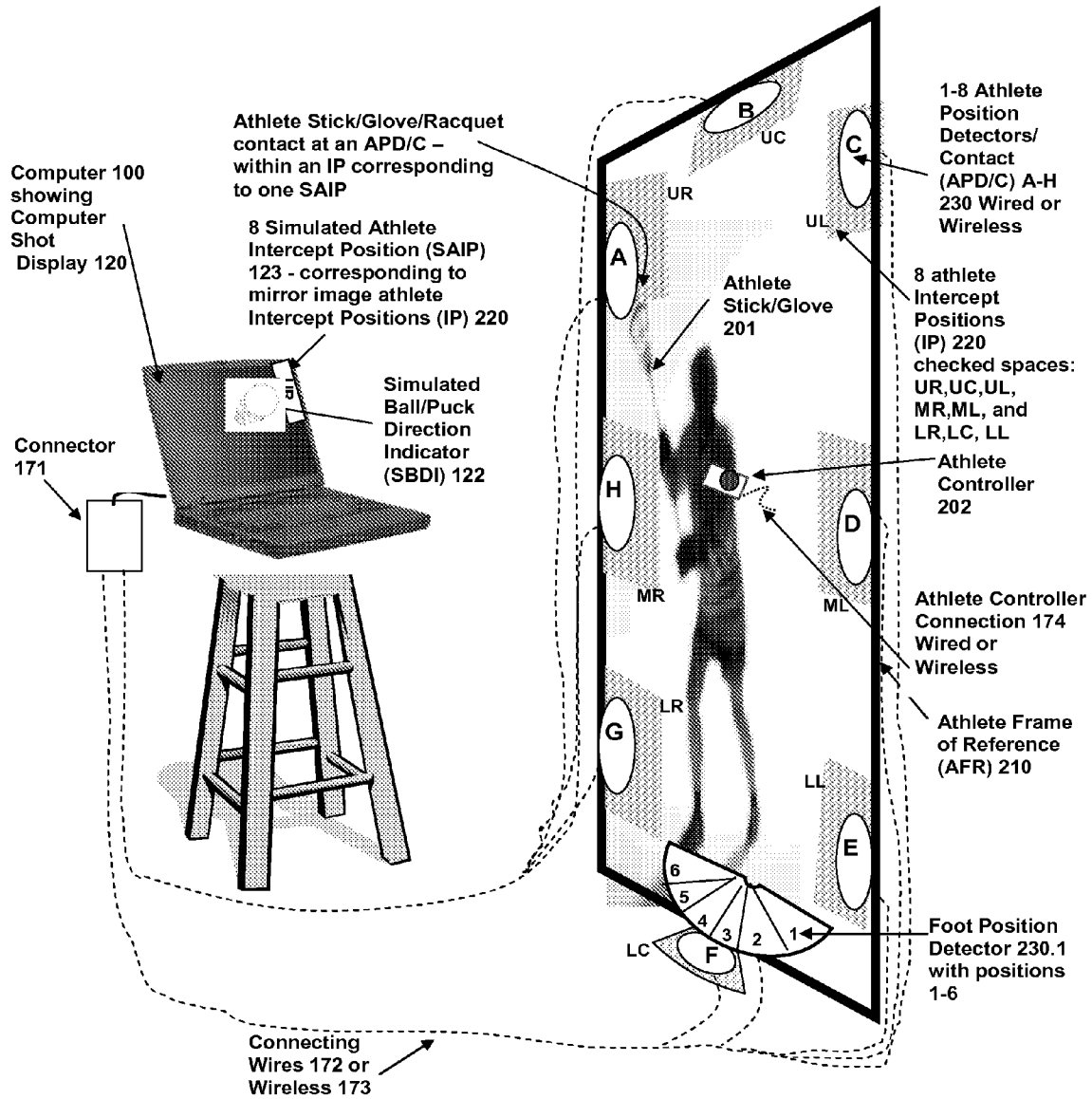


FIG. 2: System Layout Option 2: Athlete Position Detectors/Light /Magnetic on the Athlete's Frame of Reference

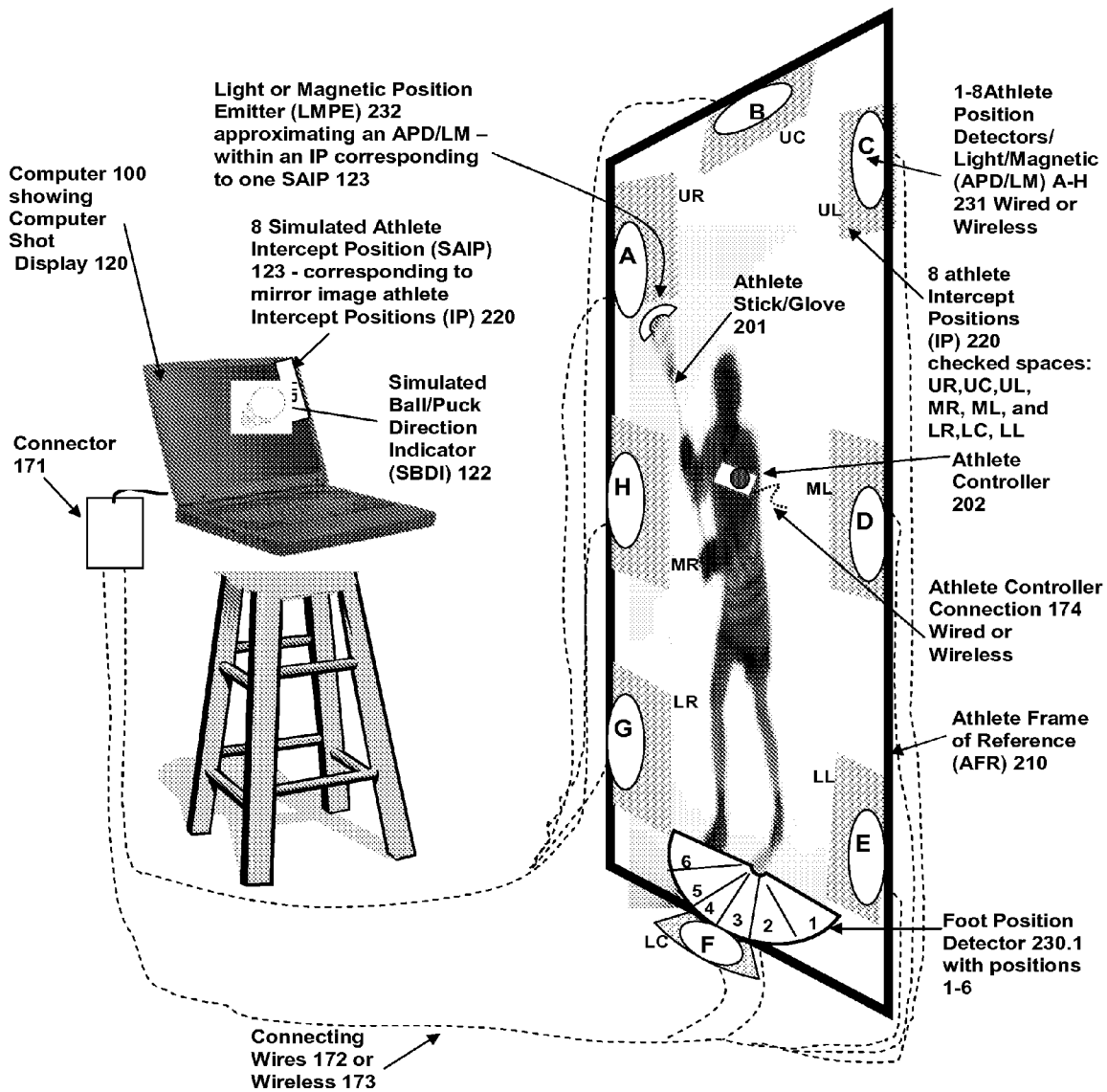


FIG. 3: ARTs Computer Shot Display 120 – Impending Shot Indicator and Simulated Athlete Intercept Positions and Simulated Foot Positions

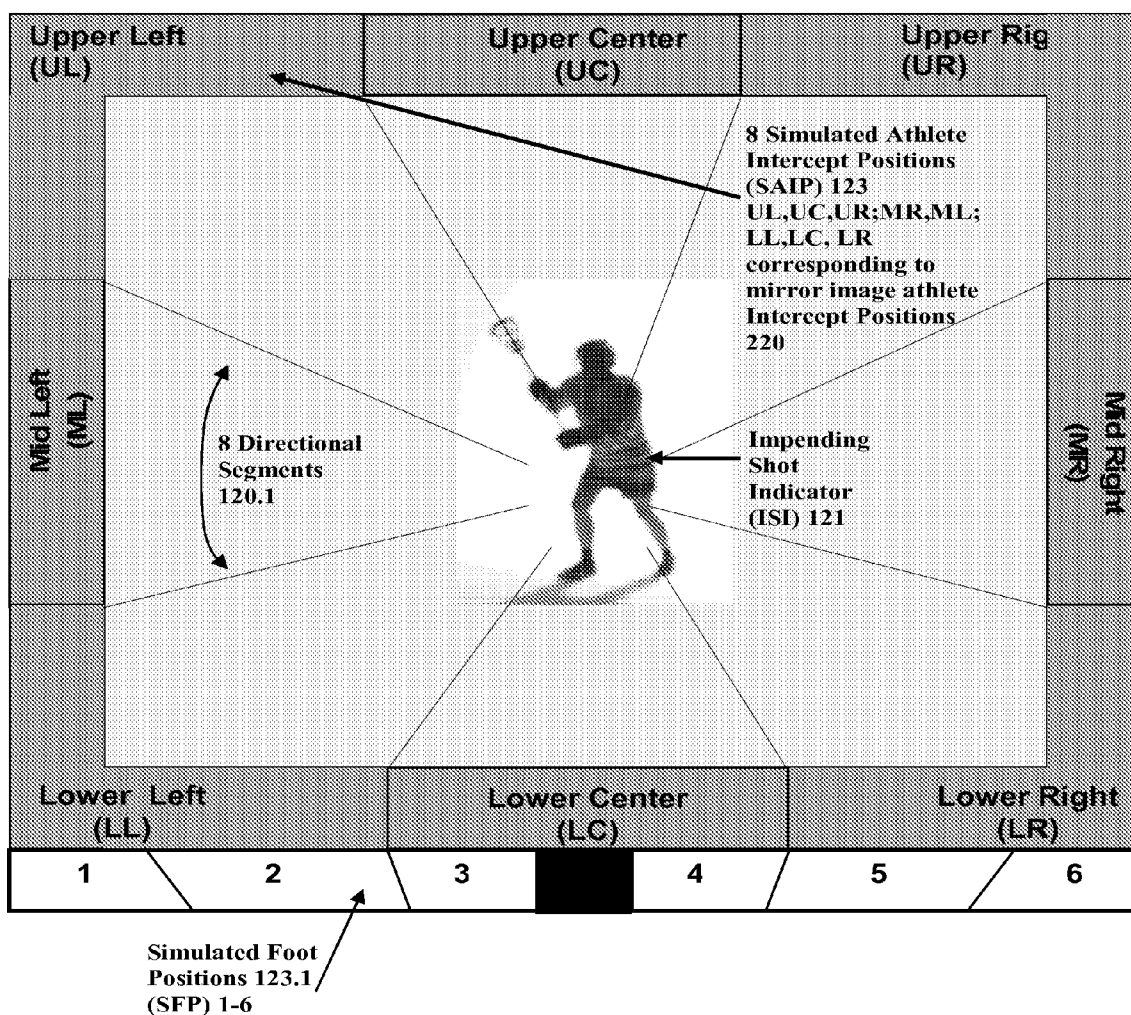


FIG. 4: ARTs Computer Shot Display 120 – Simulated Ball/Puck Direction Indicator and Simulated Athlete Position Indicators

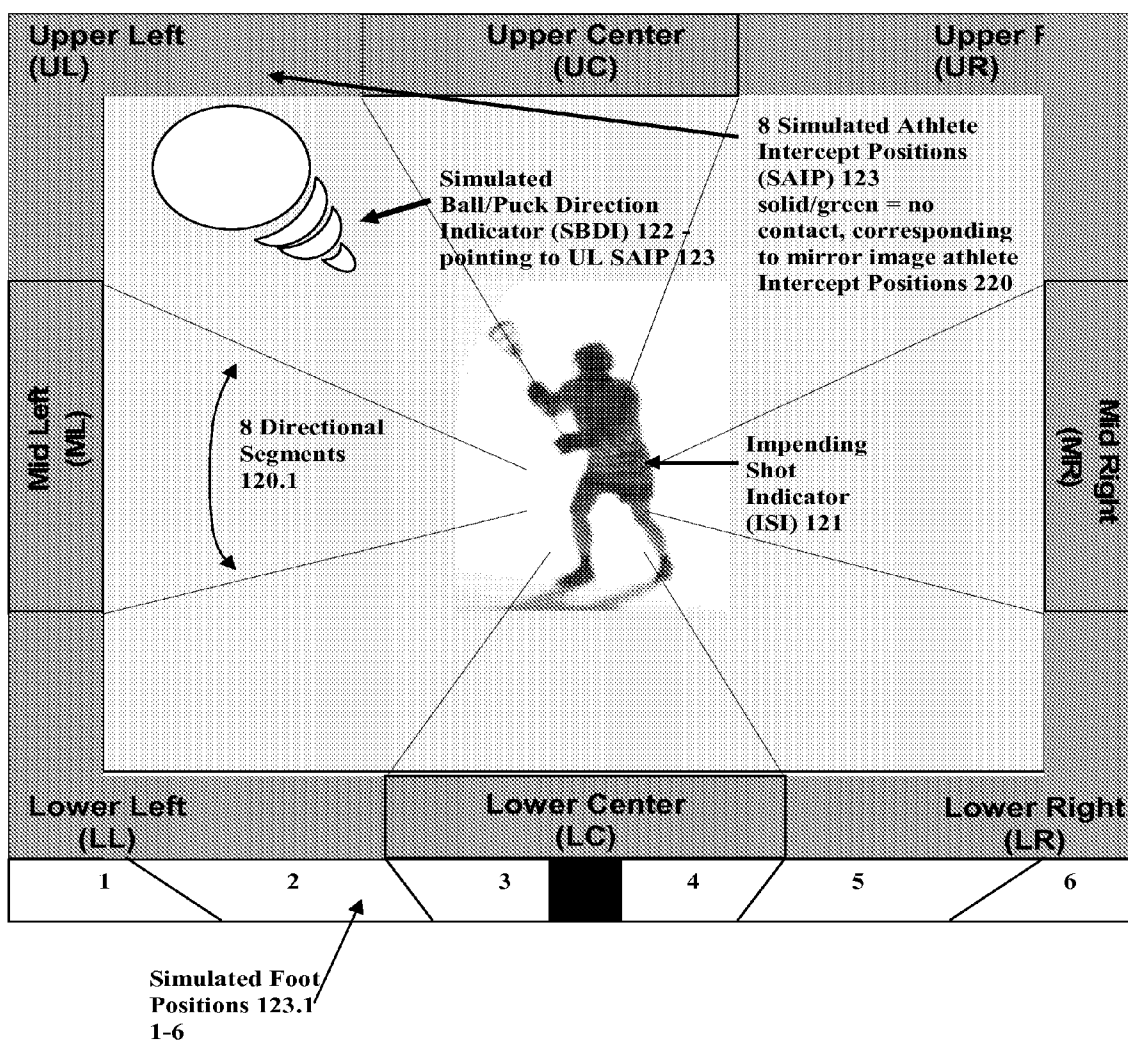


FIG. 5: ARTs Computer Immediate Results Display 130
Position Achievement, Reaction Time/Trend, Virtual Save/Intercept

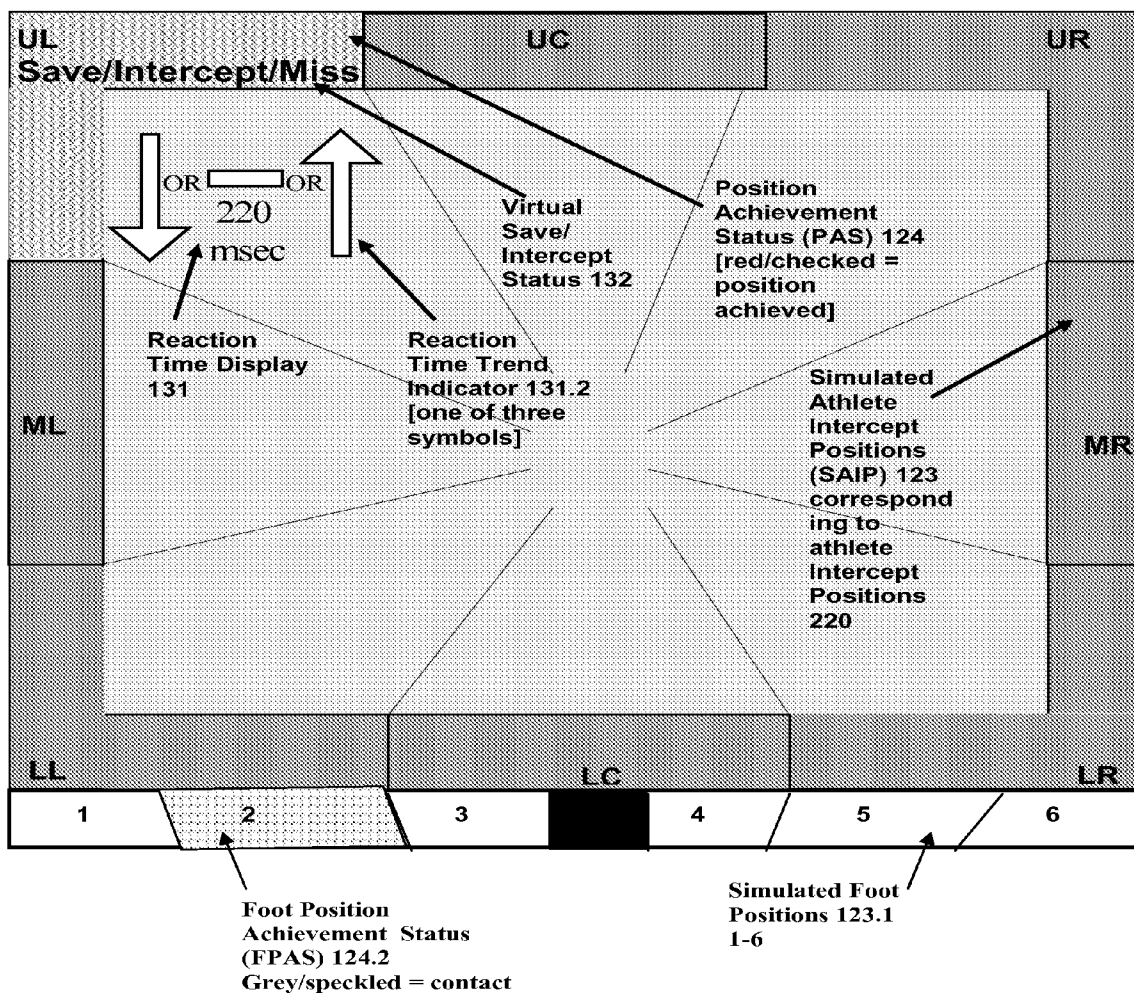


FIG. 6: ARTs End Of Session Summary Display 140 and printed report (same format)

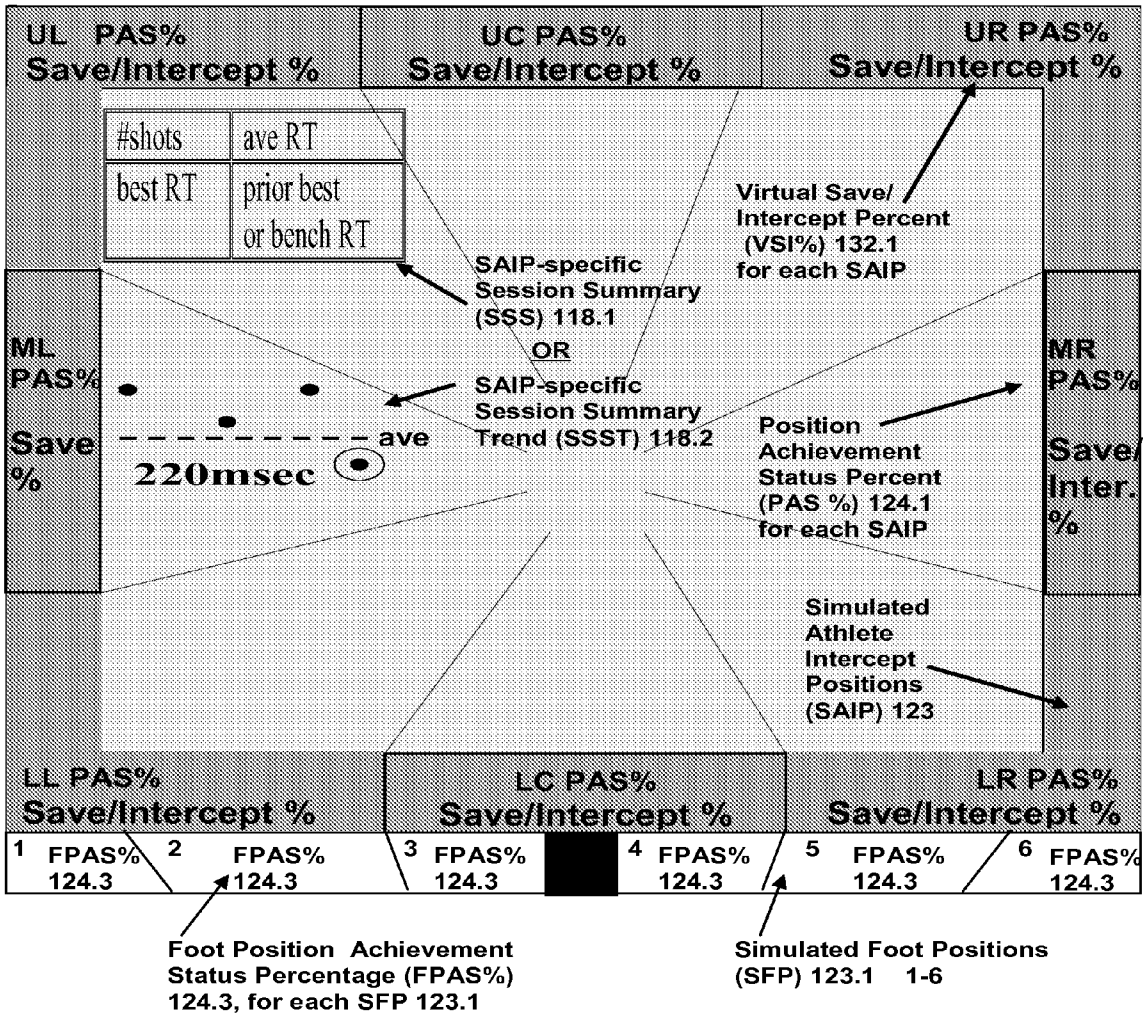


FIG. 7: Athlete Position Detectors Contact (APD/C 230) triggered and Athlete Position Detectors Light/Magnetic (APD/LM 231) triggered

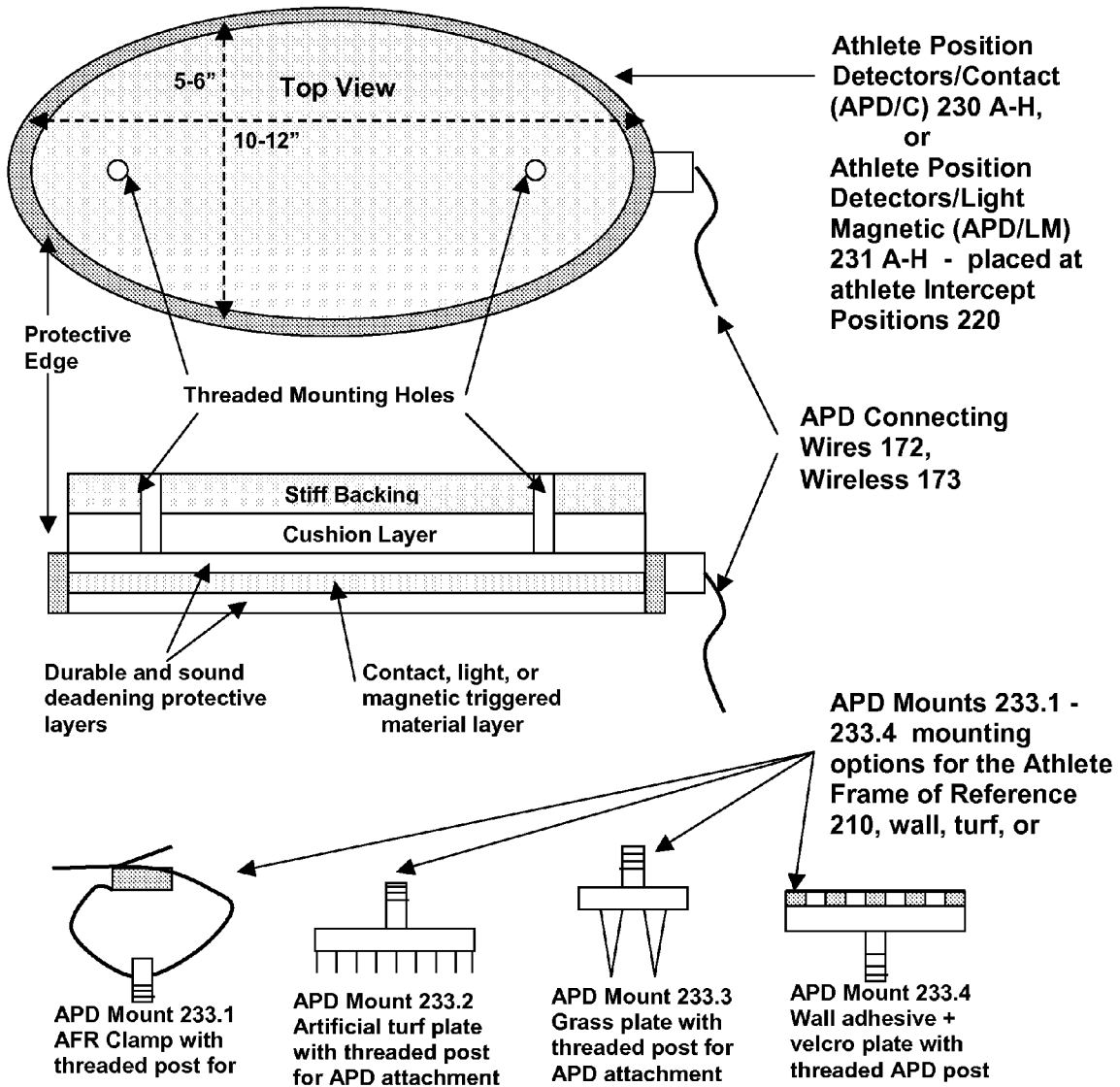


FIG. 8: Light or Magnetic Position Emitter (LMPE) 232 on Athlete's Stick/Glove/Racquet (overall apparatus layout option 2)

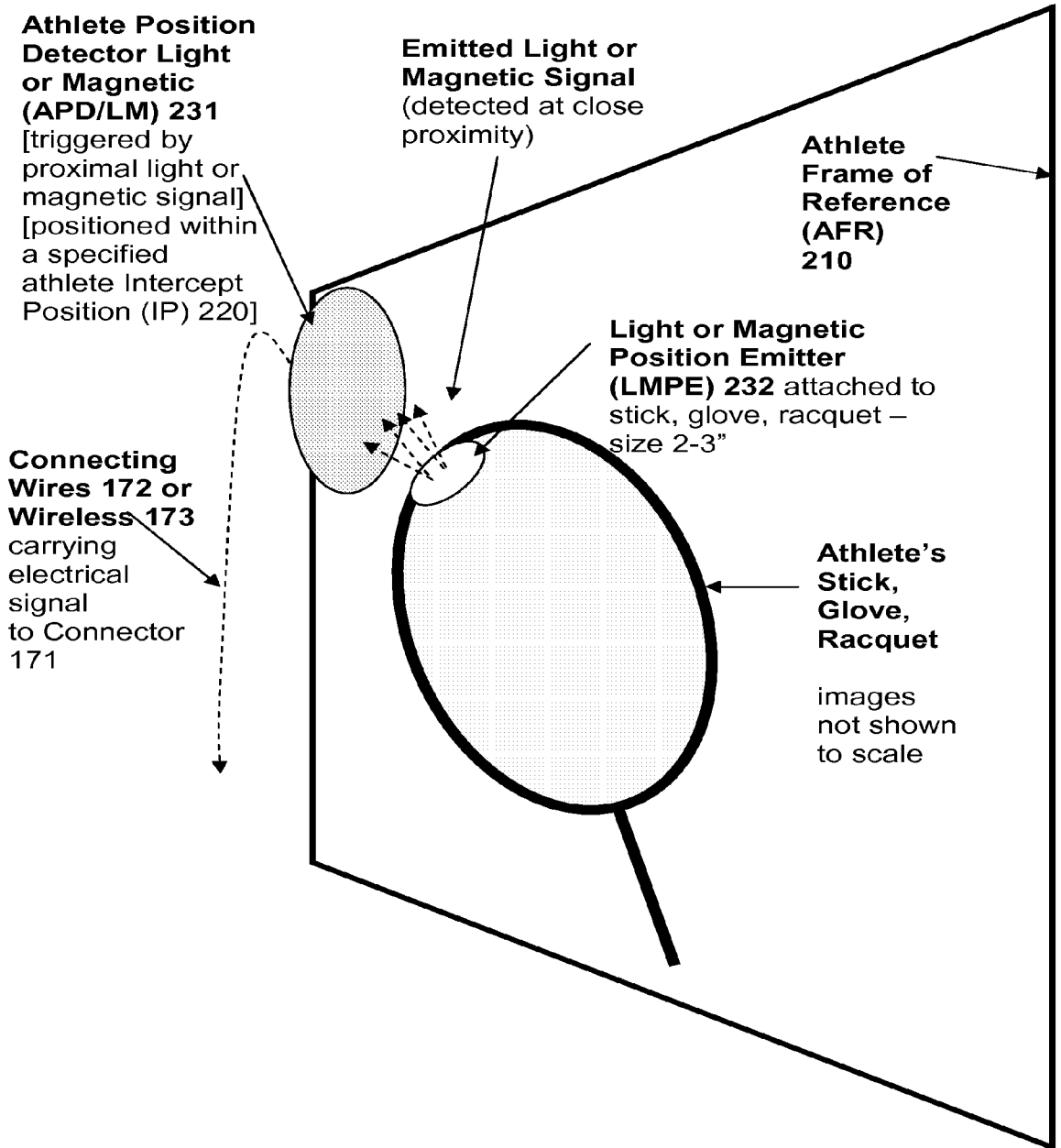


FIG. 9 ARTs Training Sequence: Intercept Position Achievement Training 310
from athlete's perspective looking through the frame of reference (outside square)
to the computer display screen (inside square)

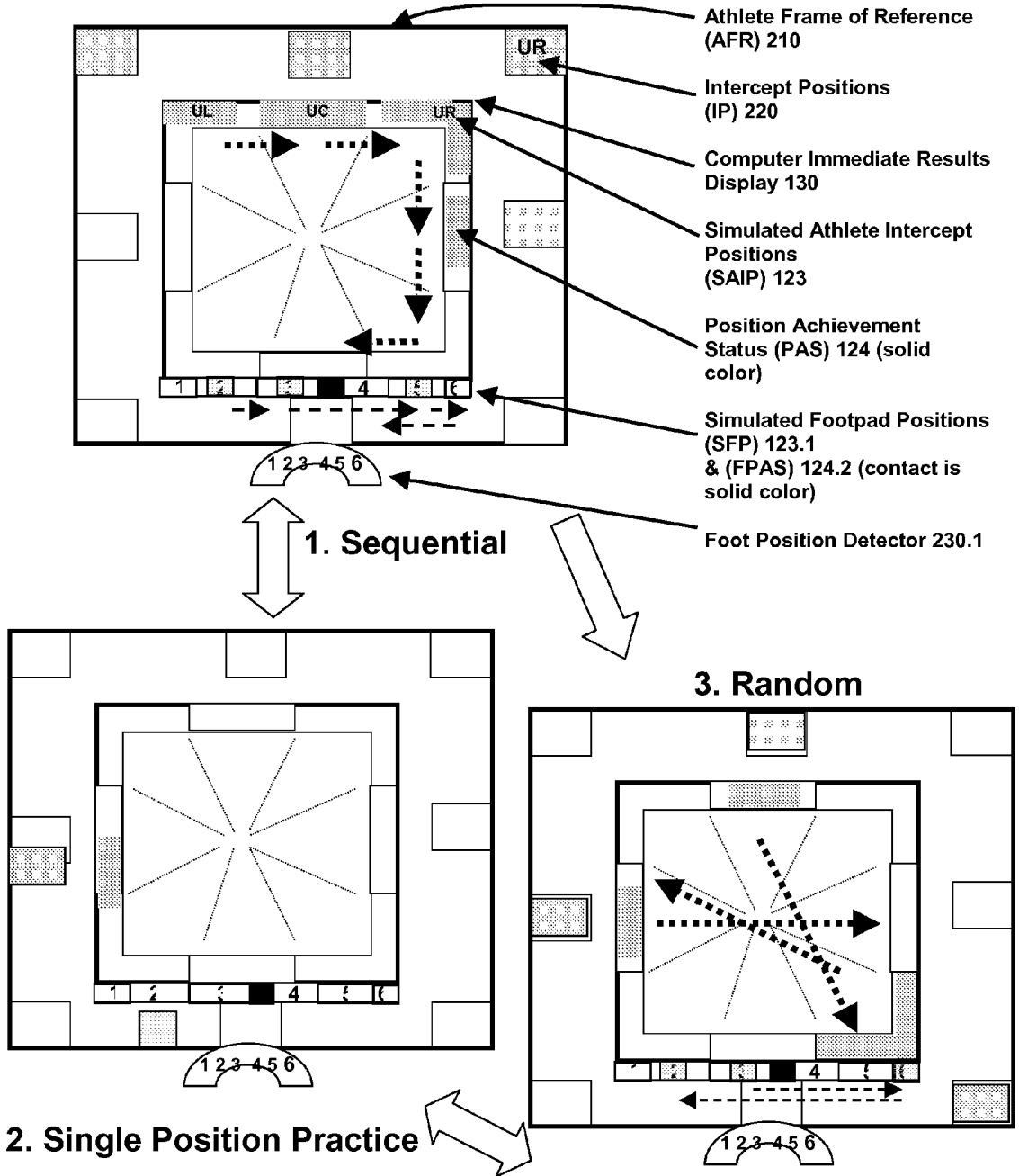


FIG. 10 ARTs Training Sequence: Reaction Time Training 320
from athlete's perspective looking through the frame of reference (outside square) to the computer display screen (inside square)

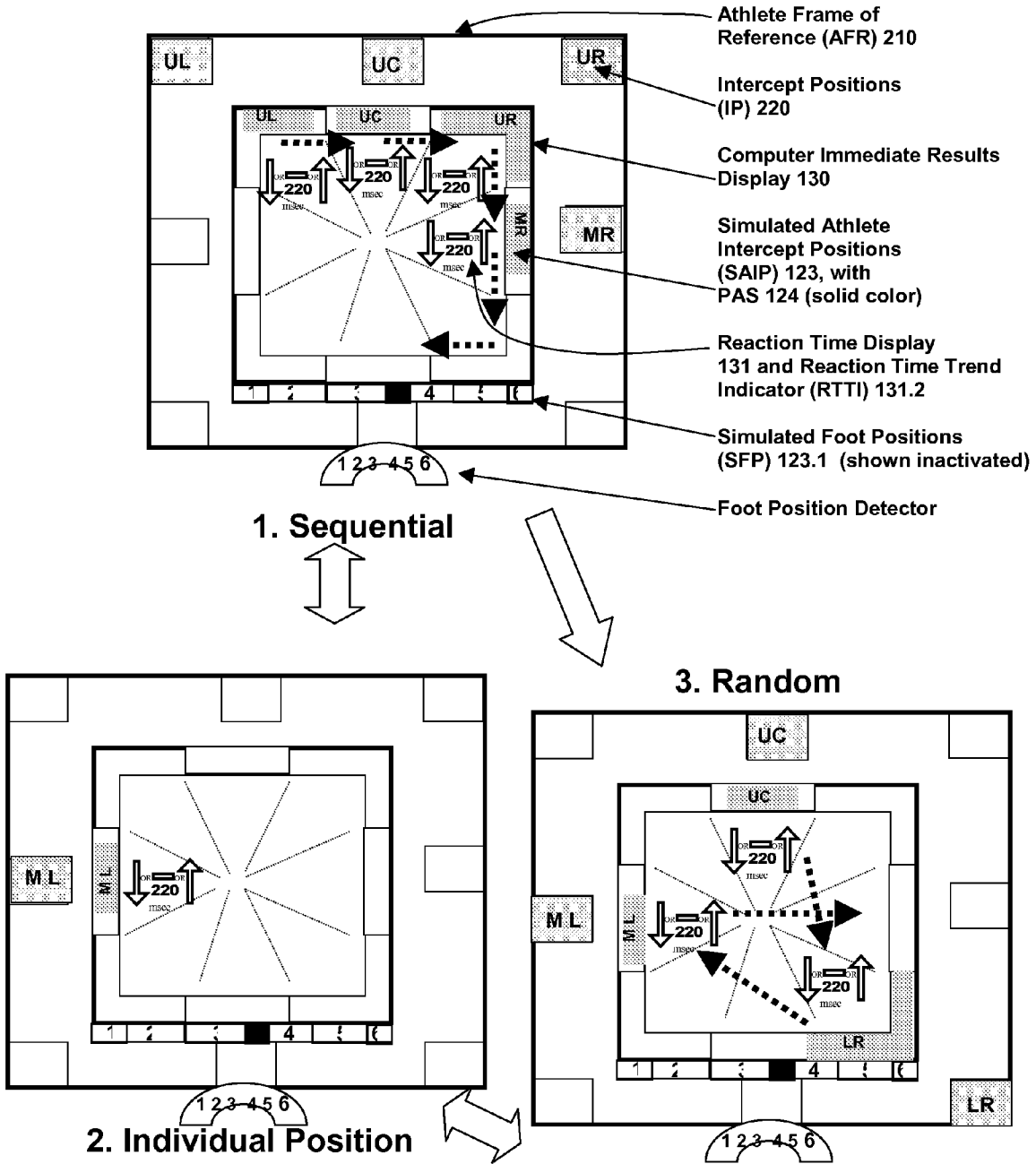


FIG. 11 ARTs Training Sequence: Virtual Save/Intercept Training 330
from athlete's perspective looking through the frame of reference (outside square)
to the computer display screen (inside square)

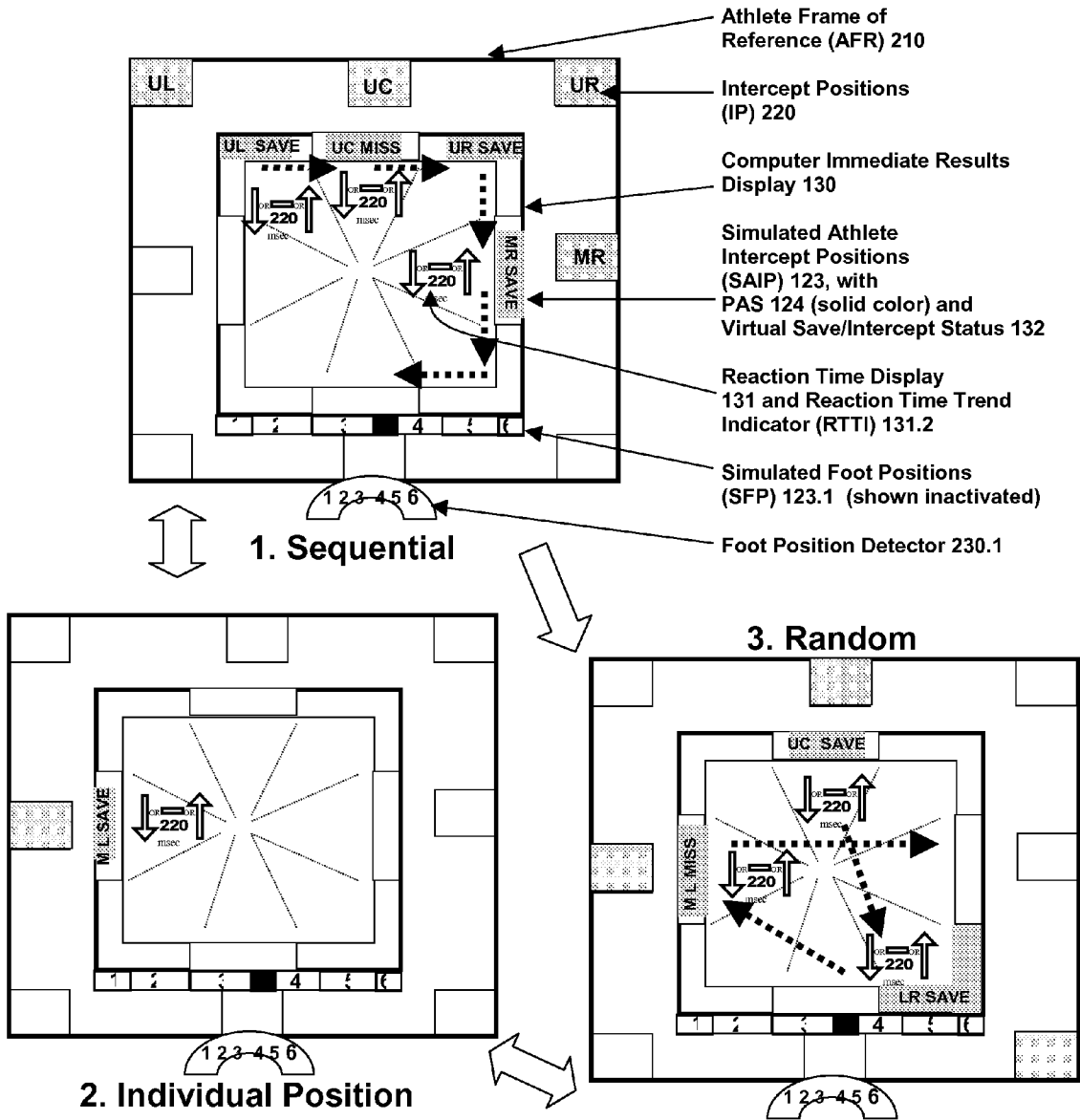


FIG. 12: ARTs Training History Summary Report 141

ARTs Training History Summary Report (random sessions only)									
Athlete Name:	Athlete Identification Data 141.1				Year in School:		Report Date:		
School:					Preset * Distance:		Preset * Ball Speed:		
Sport:					Position:		HS Coach:		
				Handed: R/L/B					
Sessions1-n	Date	LU	UC	RU	RC	RL	LC	LL	CL
	Intercept Positions 220								
	#shots								
	Position Achievement Percentage 124.1								
	Foot Position Achievement Status Percentage 124.3								
	Average Reaction Time 131.1								
	Personal Best Reaction Time 131.4								
	Average Virtual Save % 132.1								
Session..n	Dates..								
SUMMARY LAST X** SESSIONS @ consistent ball speed x, distance y									
		LU	UC	RU	RC	RL	LC	LL	CL
	Ave#Shots/session								
	Average RT 131.1								
	Personal Best RT 131.4								
	Average Virtual Save % 132.1								
	Overall Average Save/Intercept 132.1 – all IPs combined								
	Overall PA% 124.1								
* save % at preset distance X, ball speed Y – defined by coach									
** defined by coach									

ATHLETE REACTION TRAINING SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] Provisional Patent Application No. 60/863,345 Filed Oct. 27, 2006 Athlete Reaction Training System (ARTs) Thomas Clark Hawkins, inventor

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0002] Not Applicable

REFERENCE TO SEQUENCE LISTING, A TABLE, OR A COMPUTER PROGRAM LISTING COMPACT DISK APPENDIX

[0003] Not Applicable

BACKGROUND OF THE INVENTION

[0004] An athlete's reaction time to a specific intercept position is one critical skill of ball/puck sports such as hockey, field hockey, lacrosse, soccer, squash, and others—particularly for goalies, and especially for close in shots. With the current art, there is no realistic, reproducible, measurable way for an athlete to improve their reaction times from ball/puck visualization to correct glove/stick/racquet intercept positions. Current art ball/puck interception training consists of someone or a machine hitting/throwing to the athlete in repetitions, trying to be both consistent for training, and variable to reproduce game conditions. This process does not isolate or improve one central performance skill, reaction time—from visualization to attempted contact. Also with the current art, there is no way to reproducibly feedback correct first step foot position corresponding to simultaneous correct glove/stick/racquet placement.

[0005] For goalies to make critical game saves, or other athletes to make close range intercepts through improved reaction time to specific positions in games, it is difficult with the current art to improve the basic skill with shooting practice or game experience. Coaches can work with goalies one on one with position/stance and movement, but there is no way for them to reproducibly monitor on their own what they have been taught—using personal, immediate feedback.

[0006] There are no other products—not in lacrosse or hockey catalogs, sports performance web sites—for training reaction time to specific locations. There are track, swimming timing products with contact pads, auditory stimuli, designed for large meets, less for repetitive individual improvement, with the spatial movements accounted for by Athletes. Games involving reaction times are not usable for athlete training even as a basis for modification.

[0007] Swim timing contact pads are not durable enough for contact sports and other inventors have described light-based position detectors, but not the system of visual cues and athlete position specific reaction time training. More recently, a game accessory firm built a dancepad (foot contact pads) for a dance game. Scientific research firm specializing experiments and web site design can measure and reported reaction times, but they didn't have a sports application. This inventor's original idea GRAX (goalie reaction time training) was three years ago, and since then

the concept has been revised, and the application broadened to other athletes and less expensive position detection now available.

[0008] What's needed for realistic athlete reaction time training is a portable (indoor/outdoor), self-operated (no one else needed) system using an athlete's own equipment, their actual positions to intercept, with immediate feedback of reaction time to be viewed in real time. In addition for coaches and athletes, a reproducible, unbiased (anticipation eliminated through random sequencing), standardized training system—monitored for improvement using standard protocols—will improve the level of athlete performance and evaluations.

BRIEF SUMMARY OF THE INVENTION

[0009] This invention addresses the need for a reproducible, unbiased, standardized way for athletes to improve several core skills in hitting/catching/stopping an incoming ball or puck: coordination needed to place the athlete hand/foot/stick in the correct position to intercept the ball or puck, and in quick enough time to make the intercept. Athlete reaction time performance improvement requires reaction time (speed) training specific to the position the athlete needs to achieve for ball/puck interception position (muscle memory) in competition.

[0010] This Athlete Reaction Training System (also ARTs) is the computer generated visual ball/puck direction display, athlete position detectors, timing mechanism, and training system designed to improve an athlete's reaction time to specific intercept positions. Such sports include but are not limited to lacrosse, hockey, baseball, and soccer goalies and field players. Athlete ball/puck interception skills can be reproducibly and measurably improving these basic skills:

- [0011]** 1. Position achievement—the muscle memory to get stick, glove, or racquet in the correct intercept position, simultaneously with the correct first foot step
- [0012]** 2. Reaction time—from visual trigger through detection by the appropriate position detector
- [0013]** 3. Virtual Intercept or Miss—combining reaction time/position detection with calculated ball/puck speed/distance

[0014] The ARTs reaction timing system begins with a flashed ball/puck simulation, and its direction to one of eight simulated positions around an athlete on a computer screen facing the athlete. Timing stops when athlete triggers a position around them corresponding to the simulated position on the computer screen. Process is repeated with time feedback to the athlete attempting to reduce the reaction time or improve the virtual save/intercept percentage.

[0015] The ARTs training sequence consists of ARTs sessions which combine sequential, individual position, and random drills of three skills (position achievement, reaction time, and virtual intercept/save) to each sport-specific intercept position, moving from basic improvement through game simulation. The random position sequences ensure unbiased reaction times which reflect actual competition and are not influenced by biased muscle tone and premature movement. ARTs is a tool which fits within an overall athlete coaching program of position, stance, movement, footwork, clearing, game strategy—and supports, not replaces, several of the basic skills within an athletes overall performance. The system also permits coaches to evaluate this basic reaction time skill across athletes and settings in a reproducible, unbiased, measurable manner. Importantly, this

system permits this skill improvement indoors, in short sessions, and without requiring other players.

BRIEF DESCRIPTION of the SEVERAL VIEWS
of the DRAWING

- [0016] FIG. 1: ARTs Overall apparatus layout Option 1: athlete, computer, 1-8 contact triggered athlete position detectors on the athlete's frame of reference
- [0017] FIG. 2: ARTs overall apparatus layout Option 2: athlete, computer, 1-8 light or magnetic triggered position detectors on the athlete's frame of reference
- [0018] FIG. 3: ARTs Computer Shot Display—Athlete ready with impending shot indicator
- [0019] FIG. 4: ARTs Computer Shot Display—Timing begins with a simulated ball/puck direction indicator
- [0020] FIG. 5: ARTs Computer Immediate Results Display—After each shot: position achievement status, reaction time, virtual save/intercept/miss indication.
- [0021] FIG. 6: ARTs Computer End of Session Display—After each training session: all position-specific results
- [0022] FIG. 7: ARTs Position Detectors: Contact or Light/Magnetic triggered, and mounting options
- [0023] FIG. 8: ARTs Light or Magnetic Position Emitter on the athlete's stick/glove/racquet, triggering an athlete light or magnetic position detector
- [0024] FIG. 9: ARTs Training Sequence: position achievement
- [0025] FIG. 10: ARTs Training Sequence: reaction time
- [0026] FIG. 11: ARTs Training Sequence: virtual save or intercept
- [0027] FIG. 12 ARTs Training History Summary Report: printed or emailed

DETAILED DESCRIPTION of the INVENTION

[0028] As detailed below, the ARTs overall apparatus layout is displayed in FIGS. 1 and 2, with the athlete standing within or slightly behind a frame of reference, surrounded by position detectors, facing a computer screen. The two ARTs apparatus options are shown by FIG. 1: contact triggered position detectors on the frame of reference, or FIG. 2: light or magnetic triggered position detectors on the frame of reference, with one light or magnetic position emitter on the athlete's stick/glove/racquet.

[0029] In FIG. 1, computer 100 facing the athlete is connected to the Connector 171, which then connects Athlete Position Detectors/Contact (APD/C) 230 A-H by wired 172 or wireless 173 connections, and the Athlete Controller 202 by the Athlete Controller Connection 174 (wired or wireless). The APD/C 230 A-H are mounted on the Athlete's Frame of Reference 210, at Intercept Positions 220, as determined by coaches or sport standards. Upon stick/glove/racquet contact with an APD/C, a signal is sent to the Connector, and on to the computer's timing software. First step position is recorded by the Foot Position Detector (FPD) 230.1, and sent to the Connector 171.

[0030] In FIG. 2, computer 100 facing the athlete is connected to the Connector 171, which connects Athlete Position Detectors/Light or Magnetic (APD/LM) A-H 231 by wired 172 or wireless 173 connections, and the Athlete Controller 202 by the Athlete Controller Connection 174 (wired or wireless). The APD/LM 231 A-H are mounted on the Athlete's Frame of Reference 210, at Intercept Positions 220, as determined by coaches or sport standards. A single

Light or Magnetic Position Emitter (LMPE) 232 is attached to the athlete's stick/glove/racquet, and upon close approximation (contact not necessary) to an APD/LM, a signal is sent to the Connector, and on to the computer's timing software. First step position is recorded by the Foot Position Detector (FPD) 230.1, and sent to the Connector 171.

[0031] The sequence utilizing the apparatus is as follows:

[0032] The sequence utilizing the specific components, as seen in FIGS. 1 and 2, begins with the athlete standing within or slightly behind the Athlete's Frame of Reference 210 (AFR), a frame representing their competitive reference space, facing computer/game box 100 with stick/glove/racquet in hand. As seen in FIG. 3, the opening computer shot display 120 begins showing only the simulated athlete intercept position indicators 123, then at a signal from the Athlete Controller 202 to software 110, displays an impending shot indicator 121 to prepare the athlete. Within a few seconds, as seen in FIG. 4, a simulated ball/puck direction indicator 122 (SBDI) is displayed pointing to the intended simulated athlete intercept position 123 (SAIP) around the edge of the screen, and the appropriate Simulated Foot Positions 123.1 (SFP) across the bottom of the screen. Simultaneous with the SBDI display, timing in milliseconds begins.

[0033] Timing stops when athlete triggers an APD/C (230) or APD/LM (231) position detectors corresponding to the SAIP 123 on the computer display. Immediately upon APD triggering, Computer Immediate Results Display 130, is displayed, as shown in FIG. 5. This screen immediately shows the athlete for the specific SAIP 123 pointed to by the SBDI 122, their Position Achievement Status 124 if they got their stick/glove/racquet to the appropriate APD, and if so, what was the Reaction Time 131, and Virtual Save/Intercept Status 132, if activated, and finally Reaction Time Trend Indicator 131.2, a simple large arrow graphic indicating if the reaction time was better or worse than the previous for that specific SAIP 123 (which correspond to specific intercept positions 220 and position detectors 230/231 around the athlete). Virtual Save/Intercept Status is defined as when reaction time was equal or less than a preset ball/puck travel time (based on pre-set speed and distance). The Computer Immediate Results Display 130 also displays the Foot Position Achievement Status 124.2 in the appropriate Simulated Foot Position 123.1, as indicated by the SBDI 122 direction, and detected by appropriate foot contact or not on the Foot Position Detector 230.1. Specific, matching auditory messages for PAS 124, Reaction Time Trend Indicator 131.2, and Virtual Save/Intercept Status 132 can also be activated.

[0034] The process is repeated with the athlete trying different muscle tone, initial feet position, or other changes with reaction time feedback to reduce the position-specific reaction time. After all the desired intercept positions 220 have been tested, as described in the ARTs Training Sequence 300 below, and the session ends, the Computer End of Session Summary Display 140, as seen in FIG. 6, shows the summary result chart 118.1, or trend plot 118.2, for each simulated intercept position 123 (corresponding to specific intercept positions 220), and Foot Position Achievement Status % 124.3 for each SFP 123.1 assigned to an IP 220 by a coach—depending on athlete's size and handedness.

[0035] An ARTs Training Sequence 300, detailed below, uses the immediate feedback and session summaries in sequences of, first, position achievement 124 training ses-

sions, then reaction time **131** training sessions, and finally virtual saves/intercept/miss **132** training sessions, as seen in FIGS. **9**, **10**, and **11** respectively. All sessions can be summarized in an ARTs training history summary report **141** for coaches, as seen in FIG. **12**. ARTs records and feedbacks repetitively and reproducibly an athlete's critical reaction time from visualization to appropriate position of stick/glove/racquet, as well as appropriate stick/glove/racquet, and first step, placement. For a reaction time **131**, or virtual save/intercept status **132** training session to be included in a final ARTs training history summary report **141**, they must be random shot sessions, where athlete anticipation bias is removed. The training system and reporting produces standardized testing and reporting which allows athletes and coaches to make meaningful comparisons between players and over time for one core skill—position specific reaction time and related virtual intercept/miss—within the broad range of skills required to be successful at the sport.

[0036] Referring now by characters of the drawings, progressing from computer display, to athlete, to software, and finally to training related components:

[0037] The Computer **100** shown in FIGS. **1**, **2** can be a Laptop, Desktop, Game Apparatus, or Notebook Computer. Subcomponents include: Software **110**; Screens **120**, **130**, and **140**. The computer software is controlled from the Athlete's Controller **202**.

[0038] A Computer Shot Display **120** shown in FIG. **3** is the initial screen the Athlete sees, with the first prompt to prepare for a shot being an Impending Shot Indicator (ISI) **121**. Eight Simulated Athlete Intercept Positions (SAIP) **123** are displayed around the edge of the screen, and Six Simulated Foot Positions (SFP) **123.1** are displayed across the bottom of the screen. The Computer Shot Display is divided into eight Directional Segments **120.1**, from each SAIP **123** converging at the center of the screen, at the ISI **121**. After several seconds, the ISI **121** is followed by a Simulated Ball/Puck Direction Indicator (SBDI) **122**, at which time the timing starts, as seen in FIG. **4**.

[0039] The Computer Shot Display **120** can be displayed a laptop, Desktop, Game Apparatus, Notebook screen, or a projected image.

[0040] An Impending Shot Indicator **121** (ISI) at the center of the Computer Shot Display **120**, as shown in FIGS. **3**, **4**, is an image of an opposing athlete centrally located on the screen, representing an impending shot without disclosing the impending shot direction, to prepare the athlete. This indicator is the first component of the overall reaction time training cycle, a preparation stage before any timing is initiated.

[0041] A Simulated Ball/Puck Direction Indicator **122** (SBDI) is flashed after an Impending Shot Indicator **121**, in one of the eight Directional Segments **120.1** in the Computer Shot Display **120**, as shown in FIG. **3**. A Simulated Ball Direction Indicator **122** (SBDI) is a sports projectile (ball, puck, or other) graphically displayed, utilizing some directional indication to point towards one of six Simulated Athlete Position Indicators **140** around the edge of the computer screen, representing Intercept Positions **220** around a player or goalie, as seen in FIGS. **1,2**. The SBDI **122** direction to center upper or lower SAIPs (which in turn correspond to UC or LC Intercept Positions **220** on the AFR **210**) dictates the appropriate first step positions **3-4** on the Foot Position Detector **230.1**. A SBDI **122** direction to right mid-upper SAIPs dictates the appropriate first step to FPD

230.1 positions **4-5**. A SBDI **122** direction to left mid-upper SAIPs dictates the appropriate first step to FPD **230.1** positions **2-3**, and finally a direction to the lower corner SAIPs dictates appropriate first step to FPD **230.1** positions **1** (left) or **6** (right). The SBDI **122** represents the first moment the athlete sees the direction the ball/puck is headed, and initiates the reaction timing sequence. The ball/puck image can be size adjusted in accordance with ball/puck sizes and at standard distances.

[0042] Simulated Athlete Intercept Positions **123** (SAIP) as shown in FIGS. **3**, **4**, **5**, and **6** within the Computer Shot Display **120**, the Computer Immediate Results Display **130**, and the ARTs End of Session Summary Display **140**, are eight segments around the edge of the computer screen in mirror image to actual Athlete Intercept Positions **220** around the Athlete Frame of Reference **210**. These reference positions are the Upper Left (UL), Upper Center (UC), Upper Right (UR), Mid Right (MR), Lower Right (LR), Lower Center (LC), Lower Left (LL), and Mid Left (ML), corresponding to Athlete Intercept Positions of the same name, where an athlete has to move their hand, foot, bat, or stick to intercept the ball/puck. The edges of the computer screen facing the athlete mirror these reference positions—and are labeled as such. The primary function of the SAIP **123** is to indicate Position Achievement Status **124**, by turning red if the athlete triggered the appropriate APD **230** or **231**, corresponding to the indicated SBDI **122**.

[0043] Simulated Foot Positions (SFP) **123.1** as shown in FIGS. **3,4,5**, and **6**, across the bottom of Computer Shot Display **120**, the Computer Immediate Results Display **130**, and the ARTs End of Session Summary Display **140**, are six segments in mirror image to the positions **1-6** on the Foot Position Detector **230.1** (a seen in FIGS. **1** and **2**). The primary function of the SFP **123.1** are to indicate appropriate Foot Position Achievement Status (FPAS) **124.2**.

[0044] A Computer Immediate Results Display **130** as shown in FIG. **5**, replaces the Computer Shot Display **120** immediately after the Athlete's stick/glove activates any Athlete Position Detector (by contact, light, or magnetic activation, and consists of the following components:

[0045] Position Achievement Status (PAS) **124** as shown in FIG. **5**, is displayed as a color change from an initial background green, to a new color such as red red, within Simulated Athlete Positions **123** (SAIP), around the edge of the Computer Immediate Results Display **130**, as determined by a signal the appropriate Athlete Position Detectors. The specific APD which needs to be triggered is determined by a Simulated Ball/Puck Direction Indicator **122**. The SAIP **123** remain default green color if no position is detected by the Athlete Position Detectors. At the end of a training session, the percentage of shots to each SAIP **123** where PAS **124** was successfully achieved is displayed within the SAIP as the PAS Percentage **124.1**.

[0046] Foot Position Achievement Status (FPAS) **124.2**, as shown in FIG. **5**, is displayed within the appropriate SFP **123.1**—is dictated by the direction of the SBDI **122** and detected by the Foot Position Detector **230.1**—as described in detail above under SBDI **122**. If the appropriate position **1-6** on the Foot Position Detector is contacted, the SFP **123.1** turns from white to grey, the indication of the appropriate FPAS **124.1**. Foot Position Achievement Status may be inactivated after Position Achievement Training **310** is sat-

isfactorily completed, to reduce information feedback overload during reaction time and virtual intercept training—but it can also be left on.

[0047] A Reaction Time Display **131**, a display of a specific SAIP **123** and corresponding IP's Reaction Time Calculation **152** in milliseconds within the appropriate Directional Segment **120.1**, on a Computer Immediate Results Display **130** (see FIG. 5), next to the Reaction Time Trend Indicator **131.2**. A Reaction Time Display **131** is activated immediately after the appropriate APD is triggered. Reaction Time Calculation **152**=SBDI **122** onset to appropriate APD **230** or **231** triggering time.

[0048] A Reaction Time Trend Indicator (RTTI) **131.2** as shown in FIG. 5, is displayed within the appropriate Directional Segment **120.1** (for a specific SAIP **123**, see FIG. 5), as a simple, large graphic such as an arrow up or down indicating reaction time greater than, less than, or same as the last shot. Flat line would represent a similar reaction time. Two arrows down indicates reaction time is less than personal best, and two flat lines indicates reaction time same as personal best. These graphics permit visual feedback not requiring memory or calculation during a workout. Auditory feedback matching the RTTI **131.2** above, at, or below personal best is another option. Any time determined during a random shot session better than previous personal best, becomes the new personal best baseline. The reaction time **131** is always displayed in milliseconds next to the Reaction Time Trend Indicator. The RTTI **131.2** is based on a comparison of the Reaction Time **131** to prior Reaction Times in the Database Program **111**.

[0049] Virtual Save/Intercept Status (VSIS) **132** as shown in FIG. 5, if this feature is activated, is the Virtual Save Miss Calculation **153** displayed as a message "Save" if a athlete is a goalie, "Intercept" if not a goalie, or "Miss" within the appropriate SAIP **123**—comparing the Reaction Time **152** and Ball Time **154** calculations, and indicated as Save/Intercept (depending on the sport) or Miss in the appropriate SAIP **123**. The message can also be auditory, saying the words, so the athlete doesn't have to read the print. At the end of a session, the percent of total shots to that SAIP/IP that were saved/intercepted is displayed within the SAIP as the VSI Percentage **132.1**.

[0050] A Computer End of Session Display **140**, as shown in FIG. 6, displays the Athlete's name/date, and display's that session's summarized data for each IP/SAIP with shots. PAS Percentage **124.1** and VSI Percentage **132.1** are always displayed within the SAIP **123**, and Foot Position Achievement Percentages (FPAS %) **124.3** (if activated) are displayed within the appropriate SFPs **123.1**. The two options for displaying the remaining end of session summary reaction time data within the appropriate Directional Segments **120.1** are:

[0051] SAIP Session Summary (SSS) **118.1**, a small 2×2 table (as seen in FIG. 6) listing the SAIP/IP specific: # shots, Average Reaction Time **131.1**, Session Best Reaction Time **131.3**, and Prior Best or Benchmark Reaction Time **131.4**

[0052] OR

[0053] SAIP Session Summary Trendplot (SSST) **118.2**, a small graph (as seen in FIG. 6) displaying each shot to the SAIP/IP in sequence, in time relationship to a line representing the Average Reaction Time **131.1**. The Session Best Reaction Time **131.3** is listed under the graph, and point on the graph representing that time, is circled.

[0054] A Connector System **170**, as shown in FIGS. 1, 2 connects the computer to any of eight Athlete Position Detectors (Contact **230** or Light/Magnetic **231**), and the Foot Position Detector **230.1** directly by wires **172** or wireless **173** connections. The Athlete Controller Connection **174** connects the Connector **171** to the Athlete Controller **202**. The connector system is designed to balance durability in a rough environment with simplicity and minimal impact on the athlete's performance. The Connector **171** is point of conversion of analog to digital signals, either external or internal to the computer or gaming device, and the junction of the Athlete Position Detector connections and the Athlete Controller connections, to the computer or gaming device. If the triggered APDs can not transmit an IP-specific signal, Connector **171** can be the point of aligning each connected APD with specific electronic channels or signals for the computer, corresponding to specific IP **220**.

[0055] The Athlete related components include the Athlete **200**, and the Athlete's Glove/Stick **201** The Athlete's Stick/Glove/Racquet is their own equipment, the same weight and length used in competition

[0056] An Athlete Controller **202** as shown in FIGS. 1, 2, on the Athlete **200** is connected to the Connector **171** by the Athlete Controller Connection **174** wired or wireless, and is where the athlete can start or stop any particular set of intercept positions and reaction time and/or virtual save/intercept training sequences.

[0057] An Athlete Frame of Reference **210** (AFR) as shown in FIGS. 1, 2 is a physical frame replicating the actual space a specific athlete needs to intercept ball/pucks, of appropriate height/width for specific athlete's reaction movement, or an actual goal frame for mounting position detectors, can be indoors our outdoors, specific to each sport. The AFR **210** is in a plane aligned with or slightly in front of the athlete (some saves/intercepts are achieved by stepping to the ball/puck), and in the case of some goalies, it could be larger than the goal because goalies are in front of the goal plane and have a larger incoming space to protect than the goal size itself For this current invention, virtual shots are coming from straight ahead, and therefore the AFR **210** is similar to the space to cover behind the athlete. The athlete steps/moves correctly to the shot and moves arms/hands/stick correctly, as verified by actual detection by APD/Cs **230** or APD/LMs **231** at the IPs **220**

[0058] Intercept Positions **220** (IP) as shown in FIGS. 1, 2 are the critical Upper Right (UR), Upper Center (UC), Upper Left (UL), Mid Right (MR), Lower Right (LR), Lower Center (LC), Lower Left (LL), and Mid Left (ML) spaces around an athlete where intercepts are made, as determined by coaches or sport standards, in the in which the athlete needs move to and to intercept a ball/puck. The IPs **220** are represented on the computer screen in mirror image by the SAIPs **220**, of the same location description—UR, UC, etc. The IP **220**s, within the AFR, would typically be one step in front of, and within an AFR of similar size to the space immediately around and athlete or goal behind a goalie. The IPs **220** are the attachment points for the Athlete Position Detectors/Contact **230** A-H, or Athlete Position Detectors Light or Magnetic **231** A-H. The IPs would be in difference places, in different AFRs, depending on the sport

[0059] Athlete Position Detectors/Contact **230** (APD/C) A-H, as seen in FIGS. 1, 2, 6, and in detail FIG. 7, detect the athlete's stick/glove/racquet by contact in the appropriate IPs **220**. APD-Cs **230** are designed to balance durability in

a rough environment with simplicity and minimal impact on the athlete's performance. One of three options for detecting appropriate athlete approximation of IPs **220** (the others being light and magnetic), the APD-Cs consist of Contact Pads and Mounts. These position detectors record contact, and can be adjusted to the correct height (one reproducible standard could be the exact goal dimensions) on a goal equivalent frame or actual goal, and with spacers can be adjusted to the precise width desired (one reproducible standard is the exact goal width). They will be durable enough for hard, repetitive contact with sticks and storage, and sensitive enough to not require abnormal force (contact pads) for triggering—especially with a bat. The contact surface (contact pads) will have sound absorbing material to the greatest extent possible, and the back stiffening plate will permit a variety of attachment mounts, spacer plates, and foam/air cushioning appropriate for hand/glove contact. When triggered by contact with the Athlete's stick/glove/racquet, the APD/LM sends a signal to the Connector and on to the computers timing software, stopping the timing. APDs can be coded to produce a position-specific signal upon triggering, or, they can be used at any IP, with appropriate position assignment done through individual connections organized by IPs at the Connector **171**.

[0060] Athlete Position Detectors/Light or Magnetic **231** (APD/LM) A-H as seen in FIGS. **1**, **2**, **6**, and in detail in FIG. **7**, detect an Athlete's glove/stick/racquet position by light or magnetic field in the appropriate IP **220**. APD-LMs **231** are designed to balance durability in a rough environment with simplicity and minimal impact on the athlete's performance. These position detectors detect proximity with light or magnetic signals, and can be adjusted to the correct height (one reproducible standard could be the exact goal dimensions) on the AFR **210** with spacers can be adjusted to the precise width desired (one reproducible standard is the exact goal width). They will be durable enough for frequent accidental contact and storage, and sensitive enough to not require near contact for triggering (causing frequent accidental contact). The back stiffening plate will permit a variety of attachment mounts, spacer plates. As seen in FIG. **8**, the APD/LM **231** are triggered by proximity to one Light or Magnetic Position Emitter (LMPE) **232** attached to the athlete's stick/glove/racquet, and are tuned to react to a specific wavelength or magnetic signal from the LMPE not found usually found typical environments (to avoid interference—false triggering). When triggered by LMPE, the APD/LM sends a signal to the Connector and on to the computers timing software, stopping the timing. APDs can be coded to produce a position-specific signal upon triggering, or, they can be used at any IP, with appropriate position assignment done through individual connections organized by IPs at the Connector **171**.

[0061] A single Light or Magnetic Position Emitter **232** (LMPE) is attached to the Athlete's stick/glove/racquet, only if APD/LMs **231** are being used as seen in FIG. **2**, the second of two overall apparatus options, and uses a small magnet or battery/bulb or LED to emit magnetic or light signal. When in close proximity, an LMPE triggers the APD/LMM **231**. An LMPE **232** emits light or magnetic signals not found in the usual environment, to avoid interference and false triggering of the APD/LMs. An LMPE is the minimum size and weight necessary to emit necessary signal strength, as to not impede the athlete's usual stick/glove/racquet movement. The light emitting version would incorporate an on-off

switch to prevent battery drainage when not in use, and the magnetic emitting version would have a magnet cover to preserve the magnet when not in use.

[0062] A Foot Position Detector (FPD) **230.1**, with positions **1-6**, lays on the floor/grass/artificial turf in front the Athlete, as shown in FIGS. **1-2**, and is connected to the Connector **171** by Connecting Wires **172** or Wireless **173**. The one appropriate position of the six possible to step onto is indicated by the direction of the SBDI **122**. The SBDI **122** direction to center upper or lower SAIPs (which in turn correspond to UC or CL Intercept Positions **220** on the AFR **210**) dictates the appropriate first step positions **3-4** on the Foot Position Detector **230.1**. A SBDI **122** direction to right mid-upper SAIPs dictates the appropriate first step to FPD **230.1** positions **4-5**. A SBDI **122** direction to left mid-upper SAIPs dictates the appropriate first step to FPD **230.1** positions **2-3**, and finally a direction to the lower corner SAIPs dictates appropriate first step to FPD **230.1** positions **1** (left) or **6** (right). Upon contact by the Athletes foot in the first step into the virtual shot, the FPD **230.1** pressure sensitive detection material generates a position-specific signal through the Connecting Wire **172** or Wireless **173** to the Connector **171**, where the signal is converted from analog to digital and fed into the ARTs Computer Software **110**, Position Achievement Programs **115**. If there is a match between what the SBDI **122** indicated for initial foot position, and what the FPD **230.1** detected, then the Foot Position Achievement Status **124.2** is displayed as correct by a color change within one of six Simulated Foot Positions **123.1** across the bottom of the computer screen, from white to grey, as shown in FIG. **5**.

[0063] ARTs Computer Software **110** is a PC, MacIntosh, or Game-based program, for laptop/desktop/notebook installation. Program activation starts with onset of a signal from the Athlete Controller **202**, to the Connector **171**. A signal from Connector **171** to the computer/game apparatus initiates the Sequence Activation Program **112**, launching the Simulated Shot Program **113**, then Timing Program **114**—which ends with a signal from the Athlete Position Detector matching the SBDI **122**, that the appropriate position was achieved, reading out results PAS **124**, Reaction Time Display **131**/Trend Plot **131.2**, and Virtual Save/Intercept Status **132** immediately to the screen display with the Immediate Results Display Program **117**. At the end of training session, the ARTs Software **110** displays a Session Summary **140**, and results stored in a database **111** for later use in the Training Results Program **119**. The specific software components are as follows:

[0064] A Database and Program Manager **111** manages the prior results database all the following software components, and maintains Session Best Reaction Times **131.3**, and Prior Best or External Benchmark Reaction Times **131.4**.

[0065] An Activation Program **112** initiates the Computer Shot Screen **120** after a command from the Athlete Controller **202**, and then the Simulated Shot Program **113**—triggering components **121** (ISI), **122** (SBDI) and launching the Timing Program **114**.

[0066] A Timing Program **114** calculates Reaction Time **152** and times necessary for the Virtual Save/Intercept or Virtual Miss Program **116**, and works in conjunction with Position Achievement Program **115**. A Timing Program **114** calculates:

Reaction Time Calculation 152=SBDI to appropriate APD contact time (displayed as Reaction Time 131)

Average Reaction Time calculation 131.1=sum all RTs 152 for one SAIP/IP divided by the number of positions achieved at that SAIP/IP, for one session

Reaction Time Trend Indicator (RTTI) 131.2=current RT 152 compared to most recent and prior bests from the Database and Program Manager 111

Position Achievement Programs 115 convert position detector signals into computer and software acceptable signals—for the Reaction Time 152 and Virtual Save/Intercept 116 programs, and displays the PAS 124 by changing the background SAPI color to green. The Position Achievement Programs 115 also calculate the Foot Position Achievement Status 124.2, and displays the result as a SFP 123.1 color change from white to grey. The programs also calculates a Position Achievement Status Percentage (PAS Percentage) 124.1, for each IP/SAIP, and a Foot Position Achievement Status Percentage (FPAS %) 124.3, for a Computer End of Session Summary Display 140 and a Training History Summary Printed Report 141.

[0067] A Virtual Save/Intercept or Miss Program 116 calculates:

[0068] Virtual Save/Intercept calculation (VS) $153=RT<BT$ (assuming appropriate position was achieved)

[0069] Virtual Miss calculation (VM) $154=RT>BT$

[0070] Ball Time (BT) calculation $155=\text{time from SBDI to a specific SAIP}$, calculated to match the speed and distance of a ball or puck from visualization (represented by SBDI) to when it would be in the indicated SAIP. Example: shot direction detected 50 feet out, 90 miles an hour (132 ft/sec), arrives in 0.379 seconds, or 379 milliseconds

[0071] VSI Percentage calculation $132.1=\text{number of VS } 153 \text{ divided by the number of successful PAS } 124 \text{ for each SAIP } 123/\text{IP } 220$

[0072] An Immediate Results Display Program 117 is launched after each shot, upon the appropriate APD 230 or 231 triggering, and Position Achievement, Foot Position Achievement Status, Reaction Time, and Virtual Intercept calculations complete, and displays all the components of the Computer Immediate Results Display 130, as shown in FIG. 5, and then after a preset time or command from the Athlete Controller 202, launches another Simulated Shot Program 113.

[0073] A Session Summary Display and Printing Program 118, is launched upon completion of a session, as determined by Training Sequence 300, after the Position Achievement, Foot Position Achievement Status, Reaction Time, Virtual Intercept calculations complete, displays all the components of the Computer End Of Session Summary 140, as shown in FIG. 6.

[0074] A Training Results Calculation and Printing Program 119 is launched by keyboard command, at any time after at least one random shot session, and reviews data stored in the Database and Program Manager 111, to produce electronic or printed Training History Summary Report 141, as seen in FIG. 12

Training Related Components

[0075] An ARTs Training Sequence 300 consists of, in sequence of use, intercept position achievement training 310,

reaction time training 320, and finally virtual save/intercept training 330 sessions, as seen in FIGS. 8, 9, and 10 respectively. As seen in FIGS. 8, 9, and 10, each component also has a sequence of intercept position work, beginning with a sequential routine, individual position work as needed, and then random drills. The position achievement training 310 may be needed just once for each set of intercept positions prescribed by a coach. In particular, Foot Position Achievement Status 124.2 may be inactivated after successful Position Achievement Training, to reduce data feedback overload during Reaction Time and Virtual Intercept training. Individual intercept position work may come after the sequential routine or the random drills to improve particularly difficult intercept positions. Random drills are the only source of reaction times and virtual save/intercept percentages used for athlete assessment and inter-athlete assessment.

[0076] A ARTs Training Sequence 300 is a tool which fits within an overall Athlete coaching program of position, stance, movement, footwork, clearing, game strategy—and supports, not replaces, several of the basic skills within an athletes overall performance. The system also permits coaches to evaluate this basic skill across athletes and settings in a reproducible, measurable manner. The ARTs Training Sequence assumes a coach has specified correct stance, movement, and correct placement of the position detectors for that Athlete. ARTs Sessions may then proceed with and without the coach present, combined with visual/auditory feedback, and reports for review with the coach. This system does not teach technique, but it can report performance of changes in technique, and is no substitute for actual shots training or game experience—where the multiple other factors defining athlete performance come into play. ARTs does however, isolate the most important Athlete skills: position, reaction time, and correct glove/stick/racquet placement—and provide immediate feedback for real time improvement.

[0077] Intercept Position Achievement Training 310 sessions, as seen in FIG. 8, are designed to develop the muscle memory to get a stick, glove, or foot in the correct IP 220, and consist of a 1. Sequential routine, then 2. Individual position work as needed, and finally 3. Random drills. Correct Position Achievement Status 124 is displayed on the Computer Immediate Results Display 130 as the color green within Simulated Athlete Intercept Positions (SAIPs 123), if the appropriate APD 230/231 was triggered. Position achievement training 310 may be needed just once for each set of intercept positions IPs 220 and related APDs 230/231 in exact positions on the AFR 210 as prescribed by a coach specific to each sport. Position achievement training depends on coach prescribed stance, body/foot/arm position, stick/hand placement. The repetitions build stance, body/arm position, and movement muscle memory to the exact intercept positions, which is needed for subsequent reaction time training 320 and virtual save/intercept training 330. Position achievement training is completed when a coach defined high percentage of random sequence positions is achieved—at each IP.

[0078] An Athlete Frame of Reference 210, a structure holding the APDs, is in a plane aligned with or slightly in front of the athlete (some saves/intercepts are achieved by stepping to the ball puck). The athlete steps/moves correctly to the shot and moves arms/hands/stick correctly, as verified by actual detection by APD/Cs 230 or APD/LM 231s at the IPs 220, and displayed by the color green in the SAIPs 123, and steps forward correctly, with foot position detected by the FPD 230.1, and displayed by the color grey within the appropriate

SFP **123.1**. All repetitions include a return to the neutral position as defined by the sport. The reaction time and virtual save/intercept functions are off.

[0079] ARTs Reaction Time Training **320** begins once intercept achievement position status training **310** is completed, and is designed to improve the reaction time from SBDI **122** visualization, to the position achievement at the IP **220** specific to the SBDI **122**. Reaction Time Training **320** consists of a 1. Sequential routine, then 2. Individual position work as needed, and finally, 3. Random drills. Reaction Time Display **131** and Reaction Time Trend Indicator **131.2** are displayed on the Computer Immediate Results Display **130** within one of the eight Directional Segments **120.1** appropriate for the specific SBDI **122** displayed and PAS **124**. Reaction time incorporates visual ball/puck identification, resting muscle tone, muscle power and speed to the appropriate IP **220**, in addition to components of Intercept Position Achievement Status above. Reaction time can be practiced sequentially/predictably, but reaction times and personal best reaction times are only credible if evaluated randomly, reproducing real game conditions of unknown shot direction and position/muscle tone ready for any shot in any directional segment **120.1**, towards any IP. Simple easy to read graphics indicating higher time, lower time, or same as most recent or personal best at that location permit real-time feedback and improvement. Foot Position Status Achievement **124.2** may be inactivated for Reaction Time and Virtual Save/Intercept Training, if Position Achievement training is successful, to avoid unnecessary data feedback overload.

[0080] ARTs Virtual Save/Intercept Training **330** is designed to improve save/intercept percentages, by adding a calculated ball speed and distance to the reaction time, using the Virtual Save/Intercept calculation **153** or Virtual Miss calculation **154**. Virtual Save/Intercept Training begins once position achievement and reaction times are acceptable for any given skill level. Virtual Save/Intercept is calculated by comparing a preset Ball Time **155** (preset ball/puck speed and distance), with the Reaction Time **152** (SBDI display to APD triggering) as described under the Virtual Save/Intercept Program **116** description. Virtual Save Intercept Status (VSIS) **132** is seen after each shot within the appropriate SAIP **123**. Virtual Save/Intercept Training **330** consists of a 1. Sequential routine, then 2. Individual position work as needed, and finally, 3. Random drills. IP-specific Save/Intercept to Miss ratios identified for improvement, or below benchmarks, serve as the starting point with coaches, to start back with specific Position Achievement and Reaction Time Training sessions to improve the core skills of a Virtual Intercept. Standard Virtual Save Sessions (defined by coaches by distance, speed, number of shots, fakes) will permit comparisons and monitoring over time.

Save Session Possible Formats:

[0081]

Standard program: 5 shots to each IP 220=40 shots, at a 5 second frequency, ball speed=85 mph, distance=50 feet

Multiple variations possible: Sequence v. Random, 1-8 IP 220s tested, 1-5 shots/IP, frequency 3-10 seconds

[0082] A Training History Summary Report **141** (as shown in FIG. **12**) is a printed or emailed standard format report with the athlete's progress, showing each session's summary data,

for each SAIP **123** and corresponding IP **220**, and most recent Computer End of Session Summary **140** data. The only data displayed on this report is random shot data, to prevent position anticipation and non-credible data. This data is automatically populated by the software and cannot be changed by the athlete. In addition to the athlete's name and session dates, other data includes athlete entered data school, the session date, type of session—position, reaction time, save, and session comparison to a training history and the athlete's personal best times and save percentages. Data is organized as follows, and as shown in FIG. **12**.

[0083] Athlete Identification Data **141.1**, as seen in FIG. **12**, includes the athlete's name, address, school, position, coach, sport, training location, R/L handed

[0084] Individual Sessions Data **141.2**, as seen in FIG. **12**, includes dates, total shots, Frequency, Sequence (position achievement only), Random shots (reaction time and virtual save/intercept sessions), preset ball speed, distance

[0085] For Each Intercept Position **220** (data specific to each IP)

[0086] Session average Position Achievement Percentage **124.1**

[0087] Session average Foot Position Achievement Status Percentage **124.3**

[0088] Session average Reaction Time **131.1**

[0089] Personal Best Reaction Time **131.4** (for this report, this is the same as Prior Best Reaction Time **131.4**)

[0090] Session average Virtual Save/Intercept Percentage **132.1**

[0091] Summary Sessions Data **141.3**, as seen in FIG. **12**, includes

[0092] For each Intercept Positions **220**, averaged over last X sessions, as defined by coaches:

[0093] Average Reaction Time **131.1**

[0094] Personal Best Reaction Time **131.4**

[0095] For all Intercept Positions **220** combined, averaged over last X sessions, as defined by coaches:

[0096] Average Position Achievement Percentage **124.1**

[0097] Average Virtual Save/Intercept Percentage **132.1**

What is claimed is:

1. An athlete reaction training apparatus and software for ball/puck sports consisting of a computer or game display, with an athlete position detection apparatus corresponding to sport-specific ball/puck intercept position, and first step position requirements, which assists athletes in improving their reaction time and intercept percentages to specific stick/glove/racquet positions, using the athlete's own stick/glove/racquet.

2. Computer simulated athlete intercept positions, a method related to claim 1, which mirror the actual coach or sport determined athlete intercept positions for correct glove/stick/racquet/foot placement.

3. Intercept position-specific reaction time, a method related to claim 1, calculated from initial presentation of a computer simulated, position-specific visual projectile (e.g. ball, puck, etc), to the time the athlete triggers a position detector at the appropriate intercept position, which is immediately displayed to the athlete and recorded.

4. Comparative reaction time graphic and auditory indicators, a method related to claim 3, simple, large or loud messages indicating if the reaction time was greater or less than

the last reaction time at that intercept position, viewed during training sessions to permit real-time adjustments in muscle tone, stance, position, vision, grip, and to see the impact on reaction time.

5. Athlete compatible position detectors, apparatus related to claim 1, special adaptations of existing timing contact pads or light or magnetic detectors to the forceful conditions of an athlete's stick (and for hockey: glove and foot) and sport-specific mounting requirements, upon triggering generate a position achievement signal, starting the reaction timing sequence

6. Computer simulated incoming sports projectiles (e.g. ball, puck, etc) combining a trigger for movement initiation and reaction timing, and indication of direction to a specific athlete intercept position.

7. Virtual intercept/miss, a calculation of reaction time to a specified intercept position compared to preset ball/puck speed and distances, determining a virtual intercept or miss, and an average intercept percentage for multiple shots, for each intercept position.

8. Real time virtual intercept messages, a method related to claim 7, for each virtual intercept corresponding to an intercept position: simple, large visual or auditory cue indicating if there was a virtual intercept or miss, based on reaction time compared to a preset ball/puck speed and distance, viewed or heard during training sessions to permit real-time adjustments in muscle tone, stance, position, vision, grip, and to see the impact on virtual intercept percentages.

9. Intercept position achievement status, a calculation comparing an indicated intercept position directed by a computer generated ball/puck directional indicator, to the athlete's actual glove/stick/racquet detected position, and an average position achievement percentage for multiple shots, for each intercept position.

10. Real time position achievement messages, a method related to claim 9, for each position achievement corresponding to an intercept position: simple, large visual or auditory cue indicating if indicated position achievement was successful, viewed or heard during training sessions to permit real-time adjustments in muscle tone, stance, position, vision, grip, and to see the impact on correct position achievement.

11. A reaction training sequence for an athlete reaction training apparatus, producing non-biased, reproducible, standardized, measurable, comparable data, with individual components of, and in any combination:

- a. Athlete intercept position achievement training—improving getting the stick/glove/racquet to the correct intercept position, and the first foot step in correct position
- b. Reaction time training—improving the reaction time to the intercept positions in response to a visual cue
- c. Virtual intercept training—improving the percentage of virtual intercepts based on reaction time to specific intercept positions and preset projectile distances and speeds each consisting of sequential and repeat individual intercept position work matching athlete practice routines, and random intercept position work which simulates competition and eliminates direction anticipation and biased results, permitting reliable improvements and comparable measurements for coaches

12. A component of claim 11, a standardized training history summary report generated by the software of reaction training apparatus, reports the credible (random shots only) and comparable (standardized intercept positions and preset projectile speed and distances) results of an athlete's reaction position, time, and virtual intercept training by tamper-proof software, to the athlete for credible comparison over time, and to coaches for credible comparison over time and between athletes.

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