



Player Analysis Technology Approval report

ATLAS

Test code: PAT-24-028

Serial no: n/a

Software version(s): 2.0

Firmware version: n/a

Issue date: 31/05/23

Objective: To test and evaluate SMT's ATLAS system according to Rule 31 of the 2023 Rules of Tennis.

Result: Approved



SUMMARY

Six cameras are positioned around the court, one at each corner and two behind player benches. The cameras are connected to a courtside distribution box which provides power and transfers the camera feeds to a server. 3D ball and player trajectories are calculated, enabling in/out calls to be determined. A keyboard or programmed keypad (StreamDeck) is used to control the operation of the System, via personal computer (PC).

A video renderer creates a virtual visualisation of ball trajectories and bounce footprints, which can be output to on-court video displays. The System can provide an audible "out" call and visual indicators for line calls. The provision of line call replays to the in-stadium display can be controlled by the Chair Umpire or set to automatically send close calls.

Restrictions on the access by a player to ATLAS components during periods when coaching is and is not allowed are as follows:

| COMPONENT | NO COACHING | COACHING |
|--------------------|-------------|-----------|
| Video cameras | Permitted | Permitted |
| Loudspeaker | Permitted | Permitted |
| In-stadium display | Permitted | Permitted |

NOTE: Approval does not attempt to, nor does it in fact, establish the accuracy or reliability of data or fidelity of its transmission, including (but not limited to) the provision of 'in'/'out' decisions for the purposes of line-calling.

MAIN COMPONENTS

The main components of the System are described in table 1 and depicted in figure 1.

Table 1 - Description of the components of ATLAS.

| COMPONENT | FUNCTION(S) |
|----------------------------|--|
| Tracking cameras | Capture images of ball and players |
| Foot fault cameras | Capture images of players feet during serving |
| Courtside distribution box | Provide power and communicate between cameras and servers |
| Tracking/database computer | Combine images from cameras to determine trajectories |
| Operator computer | Allow operators on site to control the System |
| StreamDeck keypad | Allow quick control of the operator computer |
| Video rendering computer | Enable generation of 3D reconstructed image |
| Speakers | Communicate 'out' calls |
| Light Signal box | Visual communication to Chair Umpire of System status and 'in' or 'out' calls. |

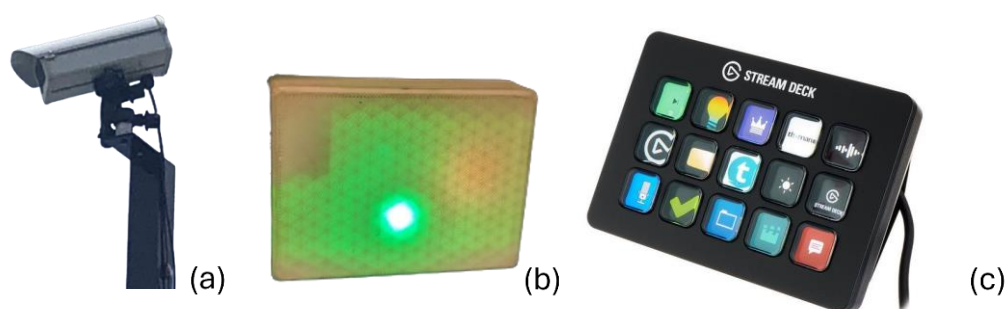


Figure 1: Hardware elements of the ATLAS system: (a) a video camera used to identify ball and player position; (b) light signal box to inform the Chair Umpire of System status and line calls, (c) StreamDeck keypad used to control the System.

DATA CAPTURE AND PROCESSING

The System employs six, fixed-position, high-resolution cameras (12 MP, 80 Hz) around the perimeter of the court to track ball and players movement. Each camera is paired with a lens to optimise the coverage and the conditions of the court. The cameras are enclosed to minimise any interference from the environment. An additional six cameras (8 MP, 20 Hz) are placed at court level to capture player foot faults.

Data is captured continually by the cameras. The camera status can be viewed via the tracking computer located in the System operator booth. If the System loses camera feeds or is unable to track the System effectively, a warning notification is sent to the operator computer.

Hit and bounce points are sent to the operator computer where the Review Official and Operator can start/stop the System and select bounce points to query. The System can provide outputs for both challenge and live (real-time) electronic line calling. Virtual replays of shot trajectories and ball impact marks relative to court lines can be produced for in-stadium displays

COMMENTS

The System functions independently of the players (does not require any player input). Transmission of data from the cameras is on a local network, limiting its susceptibility to hacking.

The System is typically run by a one trained operator alongside the Chair Umpire and Review Official who use the StreamDeck keypad to control the System in live use.

DATA COMMUNICATION

The event owner (customer) and sanctioning body determine the information that can be distributed by ATLAS.

Match statistics and virtual replays can be sent to multiple recipients including in-stadium displays and TV broadcast.

Transmission of visual information to the in-stadium display is dictated by the Chair Umpire, via radio communication with the ATLAS operator(s) and the Review Official when operating as a challenge system.

When used as a real-time system, the audible 'Out' signal can be connected to the stadium's speakers to allow communication to the Chair Umpire, players, and audience. 3D visualisations can be set to automatically send to in-stadium display when landing within a user-defined distance to the line.

Transmission of visual information to TV broadcast is dictated by the TV producer/director, via radio communication with the ATLAS operator.

COMMENTS

The event owner (customer) and sanctioning body determines the information that can be distributed by SMT.

Data output by the operator PC to the in-stadium display and TV is sent as video over coaxial cable, which is one directional and ensures the recipient cannot access or affect any part of the System.

A modular system design allows for component replacement, whilst backup measures are implemented to protect communication and data capture hardware.

ADDITIONAL INFORMATION

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