Player Analysis Technology Approval Report

Rigour Tennis ELC Live

Test code: PAT-25-034

Serial no: n/a

Software version(s): v3.0 (08/11/2023)

Firmware version: v3.0 (08/11/2023)

Issue date: 19/12/2025

Objective: To test and evaluate the Rigour Tennis ELC Live System according to Rule 31 of the 2025 Rules of Tennis.

Result: Approved

SUMMARY

Eight cameras fixed around the court are used to capture images of play. The images are uploaded to four servers for analysis and image processing. Two workstations, connected to the servers are used to conduct electronic line calling, calculate service speed, provide technical match data analysis and create the 3D animations of ball flight and bounce mark.

The System can provide Review or Real-time line calls. Radio communication between the Chair Umpire and operators controls the information transmitted to stadium screens.

Restrictions on the access by a player to the System 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 the Rigour Tennis ELC Live System

| COMPONENT	FUNCTION(S)
Video cameras	Capture images of play
Service Monitoring Station	Manage image capture, calibration to court dimensions, and System detection
Signal monitor	Monitor feed to be sent to stadium display
Laptops – operator workstations	Allow operators on site to control the System
Display monitors	Display 3D reconstruction and monitor System performance
Chair Umpire tablet	Communicate with Chair Umpire, TV broadcaster
In-stadium display	Display match statistics and virtual replays
Two-way radio (optional)	Allow communication between Chair Umpire and Review Official
Stadium loudspeaker (optional)	Communicate 'out' calls

(a)   (b)   (c)   (d)
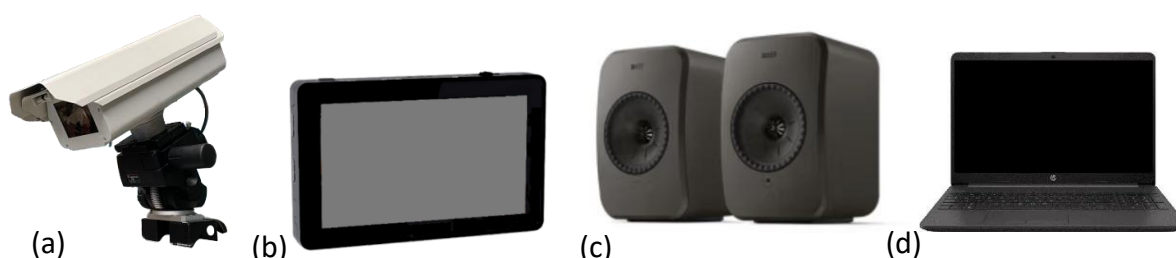
Figure 1 - Components of the Rigour Tennis ELC Live System:
(a) Video camera, (b) Signal monitor, (c) Desktop monitoring speaker, (d) Operator workstation

DATA CAPTURE AND PROCESSING

Eight high speed video cameras (100 Hz) are mounted at fixed locations around the court. A courtside network switch powers the System and connects to the cameras via ethernet cables. The images are processed by four servers, connected to a service monitoring station allowing for System control by operators. A further six cameras can be added to provide foot-fault camera feeds.

The service monitoring station manages the servers and is used for the calibration of court lines. The operator laptops allow for singles and doubles configurations to be set, as well as real-time and review system modes.

Data is captured continually with ball-surface impact points identified and marked by the software. Ball trajectories are reconstructed in three dimensions and plotted relative to the court. An audible 'OUT' call is made through the stadium speakers when the System detects an out ball bounce. 3D visualisations of ball trajectories and landing points can be requested by the Chair Umpire when used as a challenge system. When configured for real-time line calling, visualisations of close calls can be automatically sent to the stadium screens. The 'close' distance for automatic replays is user-defined.

Data generated includes the 3D trajectory of the ball and the ball speed. Service speed data can be directly transmitted to the scoring system for display, supported though User Datagram Protocol (UDP) network protocol and HDMI interfaces. Serves are automatically identified by the System. Data is not stored on removable devices and passkeys are not required to transmit data between components. Data is transmitted over a Local Area Network (LAN) connection and is not encrypted.

COMMENTS

The System functions independently of the players (does not require any player input). It is typically run by a minimum of two trained operators based on-site. A further operator is required if providing foot-fault calls.

Transmission of data from the cameras is on a wired, isolated network, limiting its susceptibility to hacking.

DATA COMMUNICATION

The event owner (customer) and sanctioning body determine the information that can be distributed by the Rigour Tennis ELC Live System.

Match statistics and virtual replays can be sent to multiple recipients. These include:
1. In-stadium display
2. TV broadcast

When used as a challenge system, transmission of visual information to the in-stadium display is dictated by the Chair Umpire, via radio communication with the Rigour operator(s) and the Review Official. The information requested by the Chair Umpire (which comprises line calls only) is sent by the Rigour operator from the second workstation to a machine controlling the in-stadium display (typically manned by a third-party operator) via coaxial video cable, following authorisation by the Review Official.

When the real-time system is in use, an audible 'out' call is communicated by a loudspeaker near the court when the ball lands 'out'.

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

COMMENTS

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

The transmission of visual information from Rigour to the in-stadium display is at the request of the Chair Umpire and subject to approval by a Review Official. When the real-time system is in use, an audible 'out' call is communicated by a loudspeaker near the court.

TV broadcast may show coaching information. Therefore, it is important that players do not have access to TV when coaching is prohibited.

Data output by the control PC to the in-stadium display and TV is sent as video over unidirectional HDMI cable to ensure the recipient cannot access or affect any part of the System.

ADDITIONAL INFORMATION

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