



Player Analysis Technology Approval report

FOXTENN Diamond-Player Pro-Performance Court

Test code: PAT-16-014

Serial no: n/a

Software versions:

iOS 1.1

Windows 1.1

Firmware version:

F-1.0

Issue date: 31 May 2017



Objective: To test and evaluate the FOXTENN Diamond-Player Pro-Performance Court (FOXTENN Diamond) Player Analysis Technology according to Rule 31 of the 2016 Rules of Tennis.

Result: Approved

SUMMARY

Multiple high-speed cameras and high-frequency laser scanners fixed around the court are used to capture player and ball trajectories. The cameras and laser scanners are wired to a server. A designated operator controls the system via software running on a second server (connected to the first server).

Coaching information, including instantaneous ball position and player location, in addition to derived data, is available on auxiliary devices with wireless connectivity, e.g. a tablet, and (optionally) as an audio output, e.g. via loudspeakers on-court. Players automatically share data with their opponent (if the opponent has the FOXTENN user app installed).

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

COMPONENT	NO COACHING	COACHING
Video cameras	Permitted	Permitted
Laser scanners	Permitted	Permitted
Loudspeakers (with volume)	Not permitted	Permitted
Auxiliary device (e.g. a tablet)	Not permitted	Permitted

MAIN COMPONENTS

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

COMPONENT	FUNCTION(S)
Video cameras	Capture images of play
Laser scanners	Capture ball and player positional data
Hardware server	Transmit and process data, monitor status of cameras and lasers
FOXTENN Court server	Store, process and transmit data
FOXTENN Court software	Start/stop data capture, input player details and match score
FOXTENN user (player/coach) app	Display data to the user
Loudspeakers (optional)	Communicate data
Auxiliary device (e.g. a tablet)	Communicate data

Table 1. Description of the components of the FOXTENN Diamond system.



Figure 1. Main components of the FOXTENN Diamond system (from left): video camera, laser scanner, speaker and auxiliary device (tablet).

DATA CAPTURE AND PROCESSING

Multiple (typically 2-8) high-speed (typically 120-2,500 Hz) cameras mounted around the court are used to capture images of play (see figure 2).



Figure 2. Cameras (circled) and laser scanners (marked by squares) fixed around the court.

The cameras are connected to a central ('hardware') server via Ethernet cable. In addition, multiple (4-10) high-frequency laser scanners fixed on the court collect ball and player positional data. The laser scanners are also wired to the hardware server, and synchronised with the video cameras.

A designated operator uses proprietary software running on the FOXTENN Court server to: select the players from a database; determine the period of data capture (i.e. start/stop the system); and monitor the match score. The software also processes the data from the hardware server to reconstruct the trajectories (in three dimensions) of the ball and the players relative to the court.

The trajectory data are combined with the match score to derive contextual (event based) data on the match. Data generated includes time histories of: position of the ball and players in three dimensions; instantaneous speeds of the ball and players; identification of ball impacts (with the racket and the court); classification of winners, errors, and shot type; and factors that correlate with match outcome (i.e. win/loss).

Processed data are sent from the FOXTENN Court server to an auxiliary device (e.g. a tablet) via a password-protected wireless (Wi-Fi) connection.

COMMENTS

The system functions independently of the players (does not require any player input). It is typically run by a single operator.

Transmission of data between data capture and processing components is wired, limiting its susceptibility to hacking. Transmission of data from the wired network to the user's device (e.g. a tablet) is done via a password-protected wireless (Wi-Fi) connection.

DATA COMMUNICATION

Data are stored on the FOXTENN Court server and managed using FOXTENN Court software.

Visualisations of the processed data, and video replays, can be viewed on an auxiliary device, e.g. a tablet or on-court screen, using the FOXTENN user app. The app is installed by invitation only and is registered to the user's device. Data can only be downloaded to registered devices.

Information available in the FOXTENN user app includes:

1. Match statistics, e.g. serves won, break points saved, net approaches, winners and errors (automatically determined as forced or unforced);
2. Video replay from multiple viewpoints with automated play-by-play commentary and 2D virtual replay of points;
3. Distance travelled, speed and acceleration of the players (per point and per hit);
4. Shot placement (e.g. central or wide) and shot identification (forehand, backhand, volley, serve), ball speed and rally length;
5. Event and positional filtering, e.g. forehands following a serve, winning cross-court backhands, unforced errors from the back of the court.

Additionally, the system can be configured with an audio output (e.g. loudspeakers on-court) which provides real-time audible information (e.g. number of bounces in a predefined target area) to the players.

Because the match statistics and performance metrics are presented for both players, players automatically share data with their opponent (if the opponent has the FOXTENN user app installed).

COMMENTS

Coaching information is available on the auxiliary device and via loudspeakers. Therefore, players must not have access to the auxiliary devices, e.g. a tablet, and loudspeakers (audio output) must be muted/disabled when coaching is prohibited.

Players automatically share data with their opponent (if the opponent has the FOXTENN user app installed).

ADDITIONAL INFORMATION

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Date received: 19 February 2016

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Revision number: 0

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