

CourtTime: Generating Actionable Insights into Tennis Matches Using Visual Analytics

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Background

- 3D ball and player tracking technology becoming commonplace
- Smart courts provide instant feedback
- Full advantage of these technologies is not taken
 - Improve specific shots
 - Help identify player's strengths and weaknesses
 - Helps identify successful strategies



Existing tools

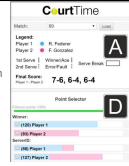
- Use summary statistics to describe a match
 - Points scored
 - Games won
 - Serve accuracy
- Use temporal and spatial information of a player
 - Player heatmaps
 - Ball landing plots



But these tools don't take into account the context of the game

CourtTime

- Use match metadata with spatial and temporal information
 - Game score
 - Who is serving
 - Serve side
 - Location of ball
 - Location of player ...



More information than summary statistics + spatial and temporal techniques

Overview of CourtTime

- Data extraction
 - Semi automated data collection
 - Annotated two matches: one professional and one amateur
- Visual analysis
 - Point selector
 - Point analyzer
 - Shot analyzer
- Video player: play points and videos of interest

Data (What)

- Two types of events (bounce events and hit events)
 - Location of ball
 - Location of player
 - Timestamp
 - Score
 - Serving player
 - Number of shots in point
 - Point outcome (winner, unforced error)



Deriving the Shot

- Aggregate bounce and hit events into a shot item (bounce-hit) or (hit-hit) -> shot
- Attributes
 - Sequence number
 - Reverse sequence number (number of shots until last shot)
 - Hitting player
 - Forehand or backhand
 - Location of ball and player for each event
- A collection of shots forms a point

Visualization

3 main components

- Point selector: Identify points to be analyzed
- Point analyzer: Used to further analyze selected points
- Shot analyzer: Used to further analyze a shot

Point selector

A search and overview task

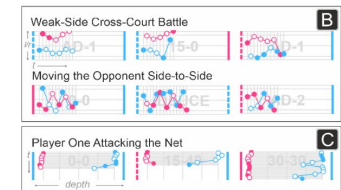
- Explore and locate points to be further analyzed
 - Search by who is serving
 - Search by points scored from a second serve
- Also gives summary level stats
 - Number of points lost with a specific stroke type
 - Number of second serves missed



Point analyzer

Allows users to look at one point with many different views

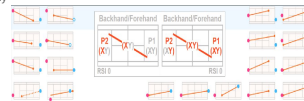
- 1-D line charts of player and ball locations for all shots in a point
- Left/right dimension or depth dimension
- Order points to help user find patterns
 - Order based on similarity of features
 - Users can select the features used in ordering
- Point analyzer + point selector help find what shots to analyze



Shot analyzer

Allows users to make a more granular analysis

- Uses player location, ball location, and shot trajectory
- Also allows ordering of shots
 - Similarity metric used
 - User can select features
- Helps users see the why
 - Trends
 - Outliers
 - Correlations
 - etc...



Strengths

- Detailed information
- Reasonable tools to help users direct analysis
 - Game-> Point -> Shot
 - Ordering
- Good use of colour as identity channel
 - Easy way to distinguish between player 1 and player 2
- 1D encoding of depth and left/right reduces cognitive load

Weaknesses

- Too many channels used
 - Hard to remember everything
- Hard to gather data
 - 3+ hours per video
 - Manually annotated

Validation

- Observe target users using the tools
 - Did they understand the needs of users?
 - Did they show the right thing?
- Is their visual encoding/interaction idiom the right one?
 - Seems promising but...
 - No comparison to existing solutions
 - Is context data necessary?