Tac-Simur: Tactic-based Simulative Visual Analytics of Table Tennis

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Introduction

**why**
- Previous tools are hard to use
- Not effective for tactic

**what**
- A tool easy to use and understand;
- A model for tactic;

**how**
- A visualization tool;
- 2nd order Markov chain model;
Table tennis match structure

Data

| Stroke placement | Position of the ball on the table tennis table after it is hit (i.e., short forehand, short middle, short backhand, half-long forehand, half-long middle, half-long backhand, long forehand, long middle, and long backhand). |
| Stroke technique | Technique used to hit the ball (i.e., pendulum, reverse, tomahawk, topspin, quick attack, smash, flick, twist, push, short, slide, block, and lob). |
| Stroke position | Position of the player when he/she is hitting the ball (i.e., forehand, backhand, backhand turn, and pivot). |
| Stroke player | Player hitting the ball. |
| Score A/B | Winner of the rally a stroke belongs to. |
| Match ID / Stroke ID | Index of the match / stroke. |

- Collected manually
- 9 kinds of stroke placement
- 13 kinds of stroke technique
- 4 kinds of stroke position

The overview of the Tac-Simur system

- **Data processing**
- **Model**
- **Visualization**
  - Navigation: locate data
  - Exploration: support adjustments
  - Explanation: provides a straightforward presentation

$G_i = \{ R_1^i, R_2^i, \ldots, R_n^i \}$

$R_j^i = \{ S_1^{i,j}, S_2^{i,j}, \ldots, S_n^{i,j}, P_j^i \}$

Simulate the stroke sequence
The First-order VS the Second-order Markov Chain Model

- Inadequate Tactic Modeling
  - considering 2 previous strokes in 2nd order Markov chain model

- Insufficient Stroke Characterization
  - expanded the number of attributes used in stroke characterization to three

The First-order VS the Second-order Markov Chain Model

Original model

New model

\[ V_k = \lambda_1 \cdot V_{k-1} \cdot T_1 + \lambda_2 \cdot V_{k-2} \cdot T_2 \]

- The different phases in a rally are simulated by different Markov processes.

Model evaluation

- Higher recall rates
- Higher precision

System design

Main view

System design

Explanation view

Let’s watch a video showing system in action

https://www.youtube.com/watch?v=_I6cne3Wd4U
System evaluation

Step 1: find pattern in tech view

System evaluation

Step 2: Generate optimum strategy

System evaluation

Step 3:
Check explanation

Analysis summary

- What: data
  Table of strokes

- How: encode
  Color, spatial, node-link
  Bar, glyphs

- How: change
  animation
Critique

Strengths:

• Provide a suitable model for the simulative analysis of table tennis;

• Design a user-friendly visualization tool.
Critique

Weaknesses:
• Fail to give proof why Markov chain is better than deep learning;
• Three features for strokes are not enough, should have the force of the stroke, rotation speed of the ball
• The way to encode stroke position is not intuitive

forehand  backhand  Backhand turn  Pivot
Thanks!