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

Jiachen Wang, Kejian Zhao, Dazhen Deng, Anqi Cao,
Xiao Xie, Zheng Zhou, Hui Zhang, and Yingcai Wu

Speaker：Wei Zheng

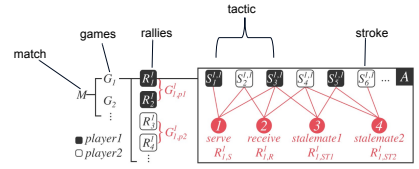
Introduction

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



[Fig 2. Tac-Simur: Tactic-based Simulative Visual Analytics of Table Tennis. Jiachen Wang, Kejian Zhao, Dazhen Deng, Anqi Cao, Xiao Xie, Zheng Zhou, Hui Zhang, Yingcai Wu. IEEE Trans. Visualization and Computer Graphics (Proc. Vis 2019), 26(1):407-417, 2019.]

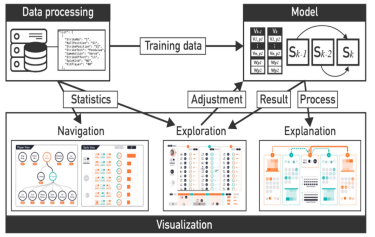
Data

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

[Table 1. Tac-Simur: Tactic-based Simulative Visual Analytics of Table Tennis. Jiachen Wang, Kejian Zhao, Dazhen Deng, Anqi Cao, Xiao Xie, Zheng Zhou, Hui Zhang, Yingcai Wu. IEEE Trans. Visualization and Computer Graphics (Proc. Vis 2019), 26(1):407-417, 2019.]

The overview of the Tac-Simur system



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

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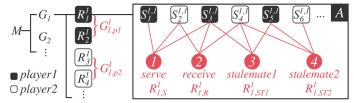
Model for simulation



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

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

Simulate the stroke sequence

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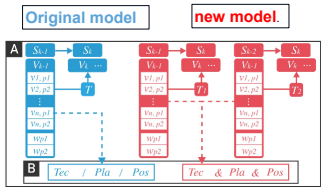
The First-order VS the Second-order Markov Chain Model



- 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

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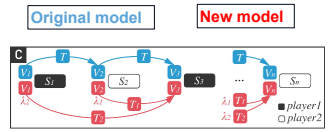

$$V_k = \lambda_1 \cdot V_{k-1} \cdot T_1 + \lambda_2 \cdot V_{k-2} \cdot T_2$$

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

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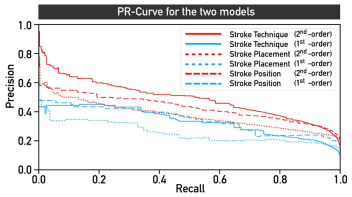
Model evaluation

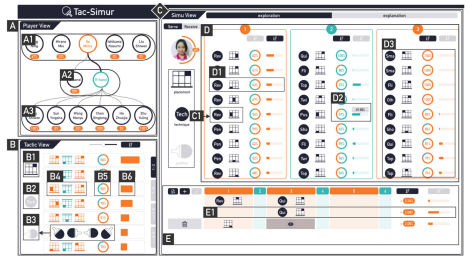


- Higher recall rates
- Higher precision

[Fig 4. Tac-Simur: Tactic-based Simulative Visual Analytics of Table Tennis. Jiachen Wang, Kejian Zhao, Dazhen Deng, Anqi Cao, Xiao Xie, Zheng Zhou, Hui Zhang, Yingcai Wu. IEEE Trans. Visualization and Computer Graphics (Proc. Vis 2019), 26(1):407-417, 2019.]

System design

Main view



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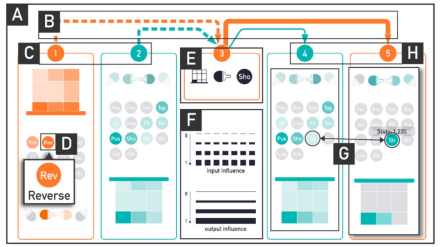
System design

Explanation view



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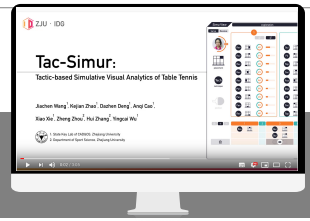
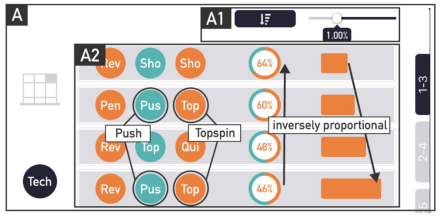
Let's watch a video showing system in action



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

System evaluation

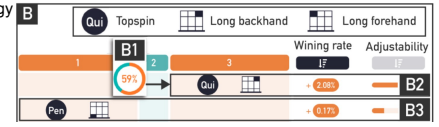
Step1:
find pattern in tech view



[Fig 7. Tac-Simur: Tactic-based Simulative Visual Analytics of Table Tennis. Jiachen Wang, Kejian Zhao, Dazhen Deng, Anqi Cao, Xiao Xie, Zheng Zhou, Hui Zhang, Yingcai Wu. IEEE Trans. Visualization and Computer Graphics (Proc. Vis 2019), 26(1):407-417, 2019.]

System evaluation

Step2:
Generate optimum strategy



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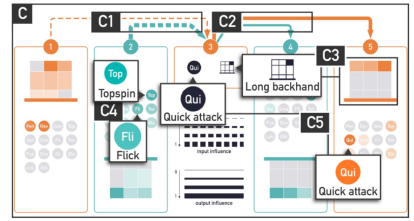
System evaluation

Step3:
Check explanation



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Analysis summary

- What: data
  Table of strokes
- How: encode
  Color, spatial, node-link
  Bar, glyphs
- How: change
  animation

Critique

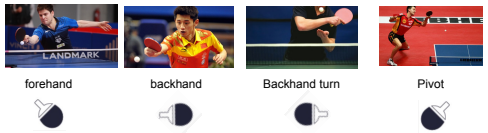
Strengths:

- 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