

### Summary

NaturalMotion investigates new ways to explore time-evolving graph data in a Matrix Cube through natural gestures in a 3D environment manipulated through user's hand gestures, as captured by a Leap Motion Controller. Virtual reality technologies may help users more naturally explore the dimensionality and richness of this 3D visualization to more effectively gain insights into the data. This synergy of data visualization and virtual reality was prototyped on a sample time-evolving graph.

### Design Rationale

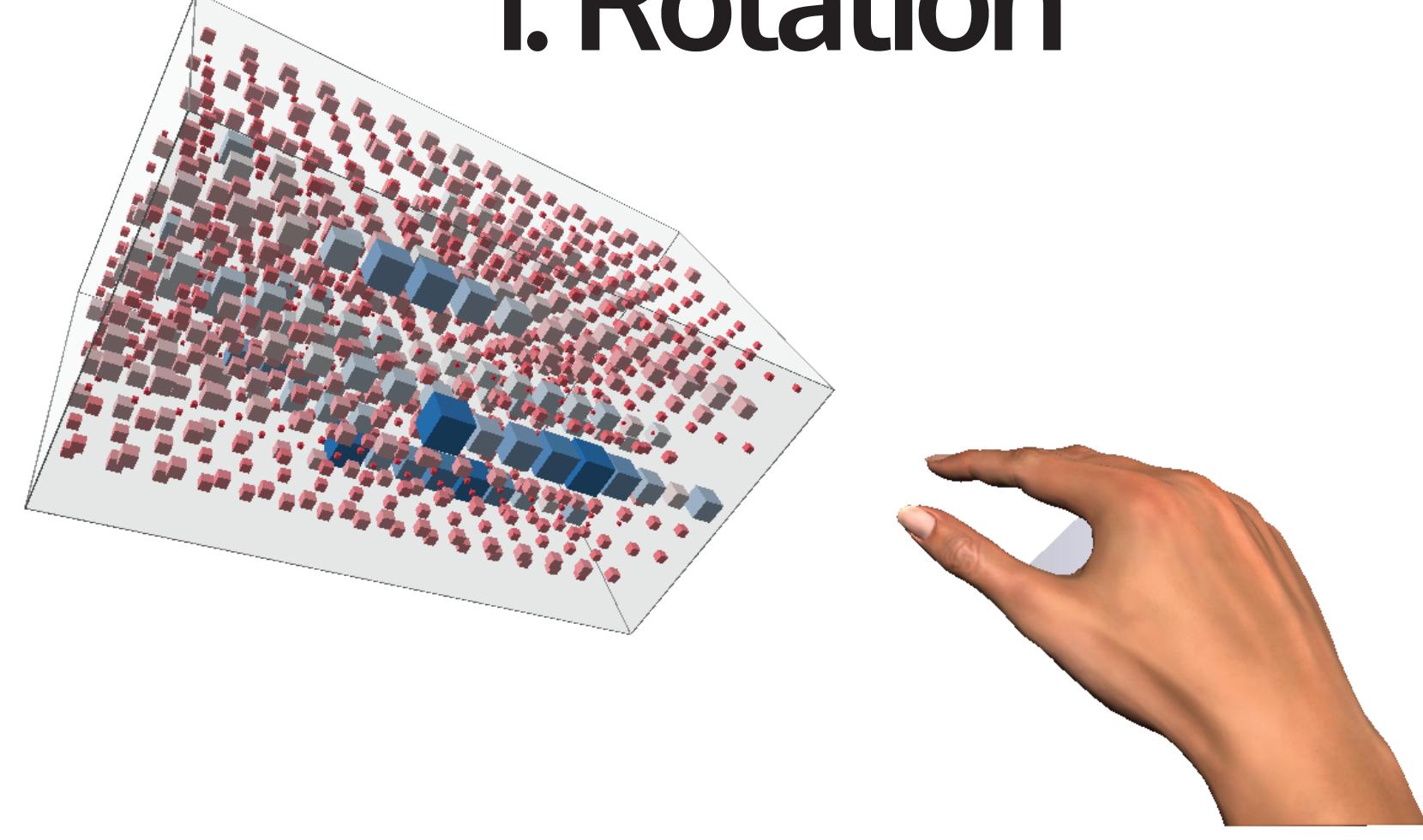
- The most essential Matrix Cube operations were implemented: rotating, scaling, color-mapping, and slice views.
- Hand gesture schemes were designed to perform these operations and transition between the different projection views of the cube.
- The rendered hand gives real-time visual feedback as to the location of the user's hand in the virtual 3D space.
- Manipulation operations are detailed below.

### Future Work

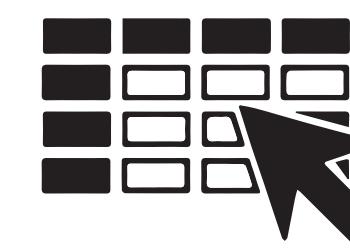
- Develop additional gestural interaction techniques, completing feature parity with Cubix.
- Conduct a user study to evaluate the usability and effectiveness of these interaction techniques.
- Try visualizing larger graphs to push the limits of the visualizations.
- Investigate the effectiveness of rendering the visualization in a more immersive stereoscopic display (e.g., the Oculus Rift).



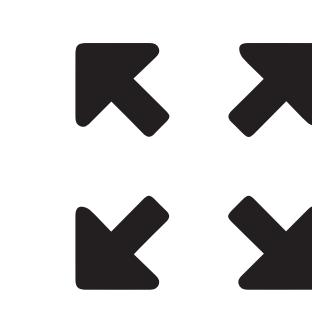
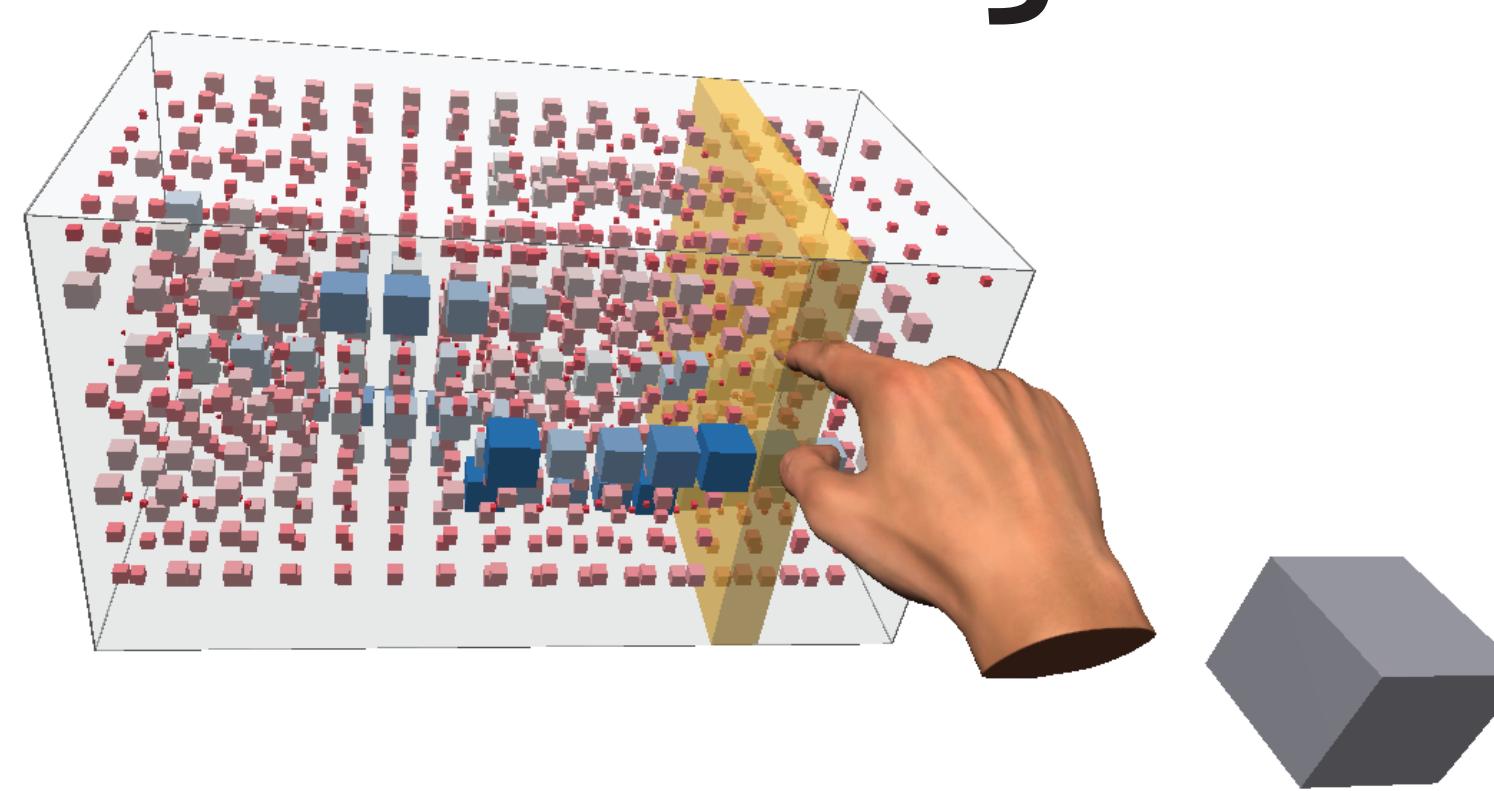
1. Rotation



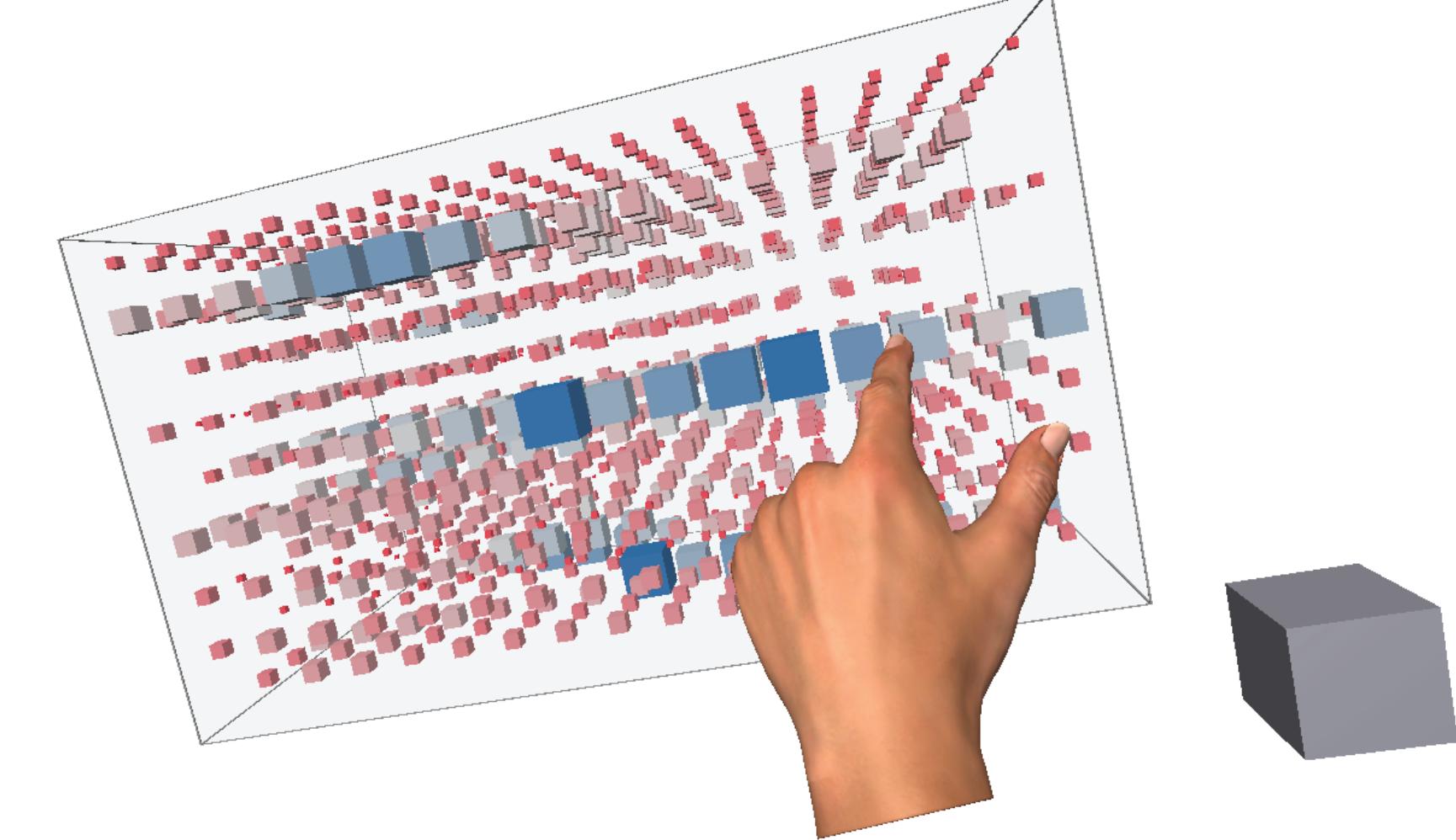
### Overview Cube Operations



2. Slicing

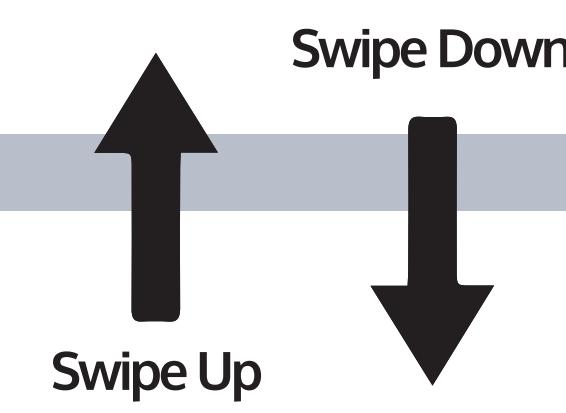


3. Scaling



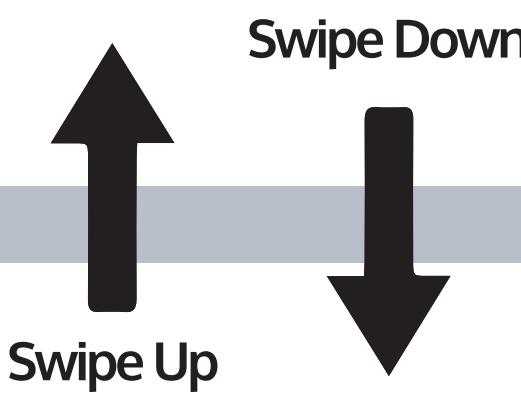
### Multislice View

Swiping left or right pages through sets of slices, while making a circular motion scrolls rapidly. Swiping vertically transitions to the other views.



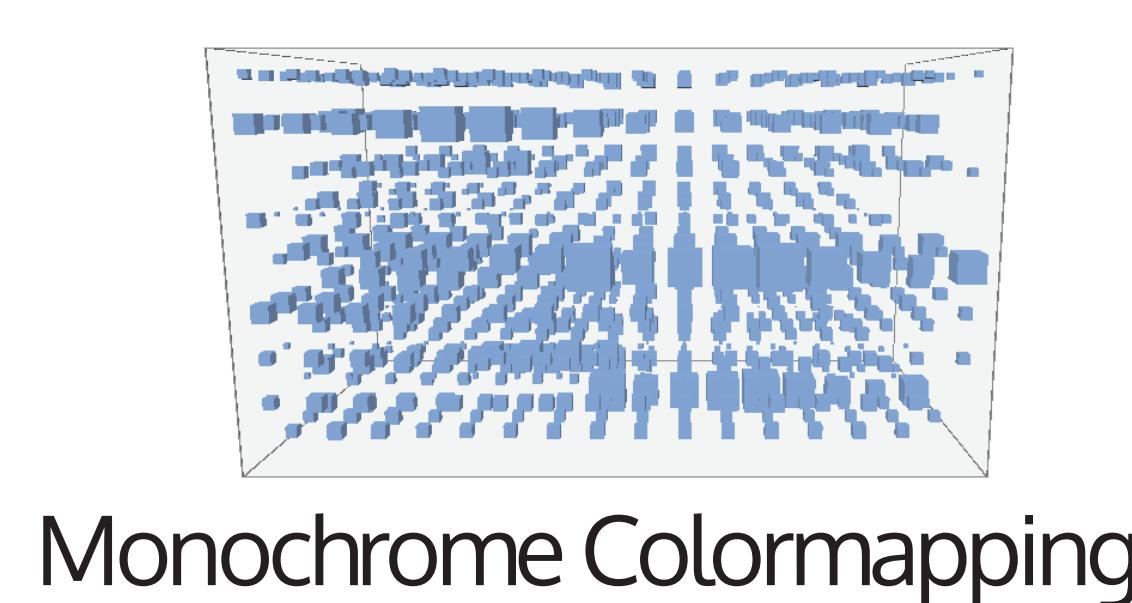
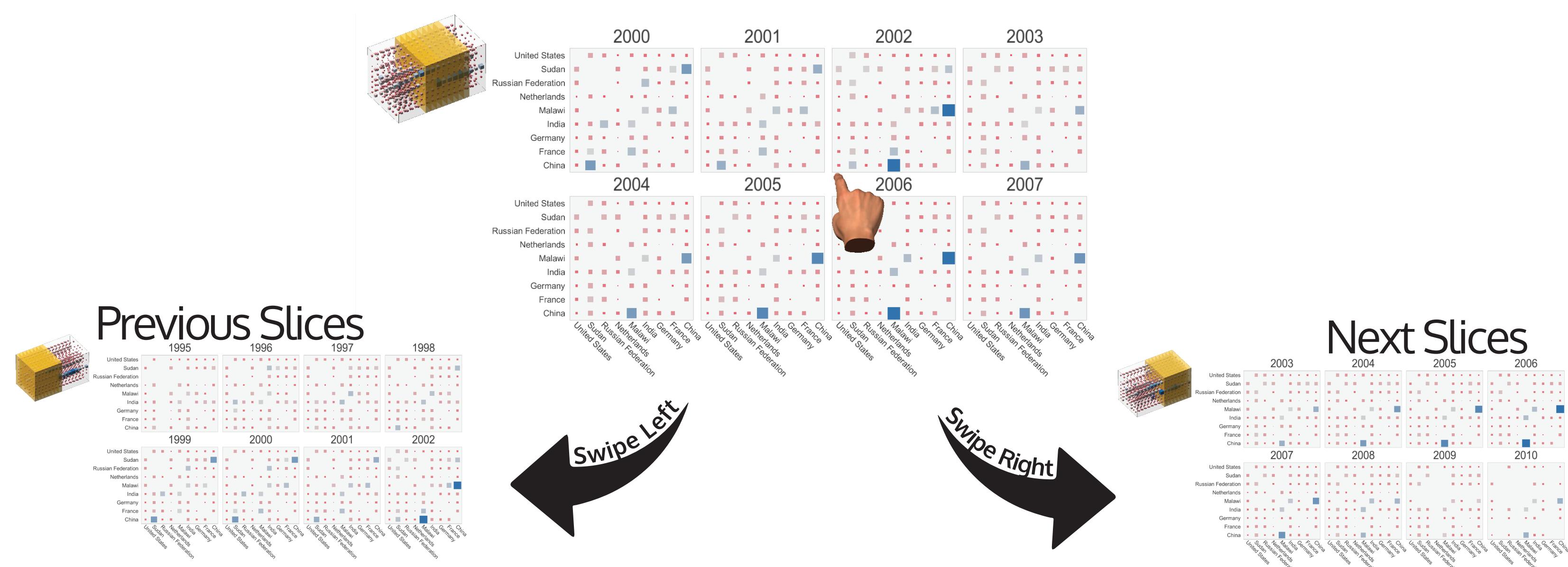
### Overview Cube

The Overview Cube Operations shown above may be performed, and swiping horizontally changes the color mapping of the cube.

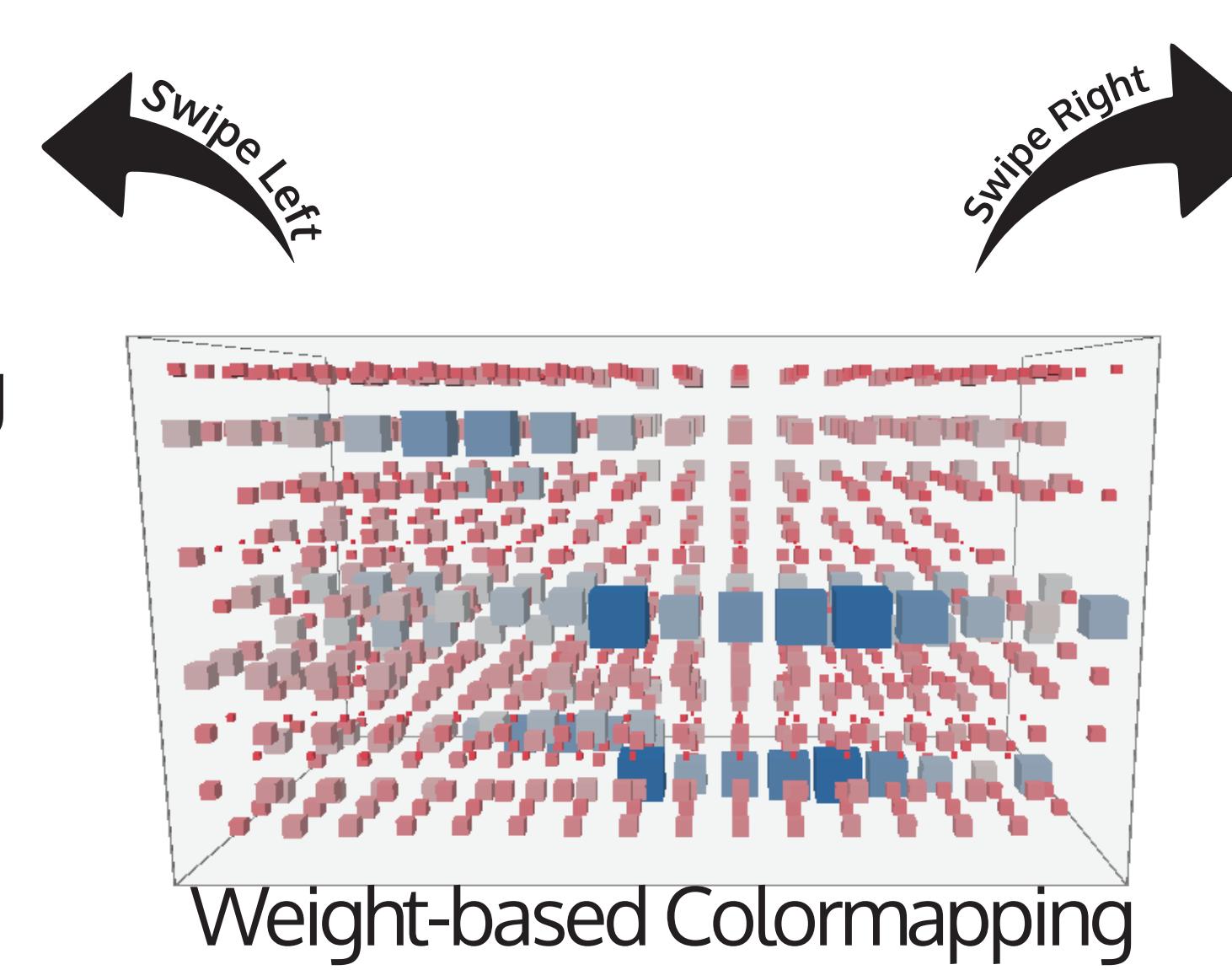


### Single Slice View

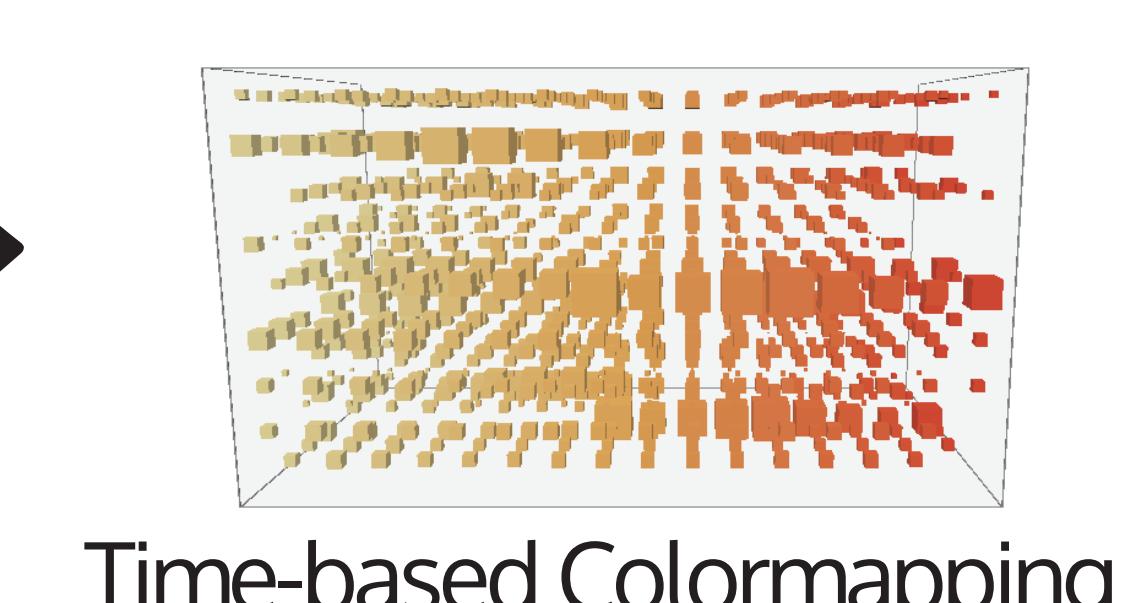
Swiping left or right advances or backtracks from each slice, while making a circular motion scrolls rapidly. Swiping vertically transitions to the other views.



Monochrome Colormapping

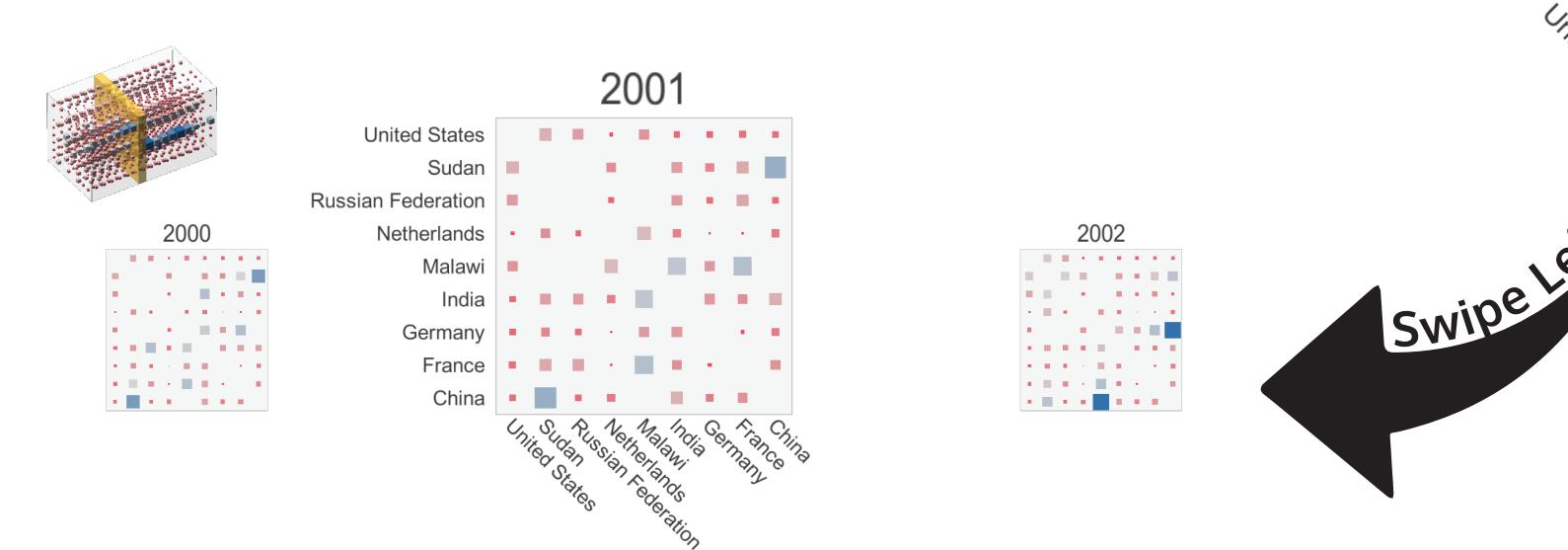


Weight-based Colormapping



Time-based Colormapping

Previous Slice



Next Slice