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Interactive Visualization and Comparison of Graphs in Virtual Reality

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Abstract

As virtual reality hardware becomes more mature and affordable its use in information visualization is getting more common. We explore possibilities for the visualization of graphs in an virtual reality environment with focus on intuitive interaction, automatic layout generation and dynamic visualization of additional vertex attributes. Furthermore we analyse methods of creating a comparison view between two graphs with common vertices in this virtual reality environment. We show an exemplary use case of such a visualization with the use of sample data from bioecological coexistence simulations.

Overview

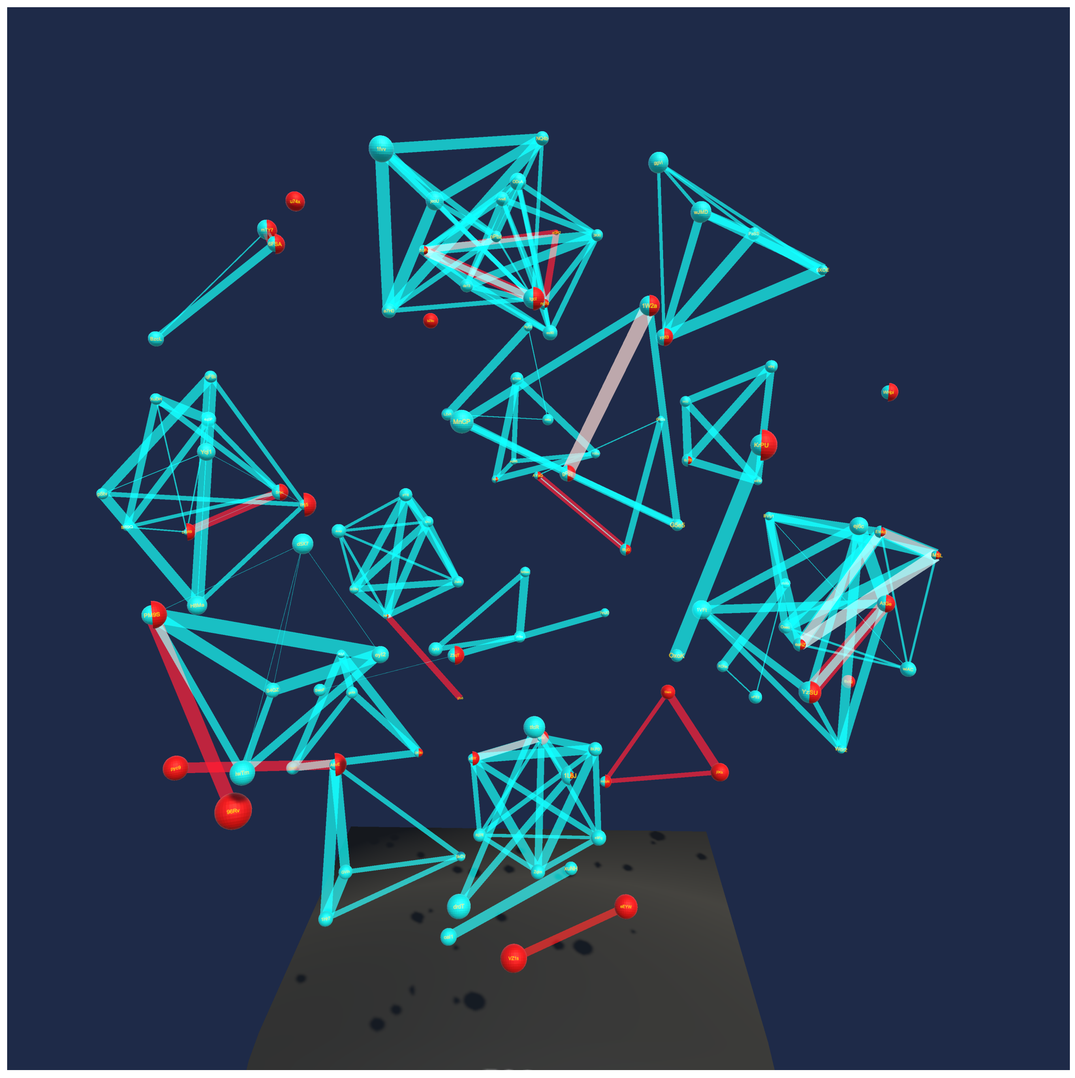

Figure: In-game overview of the application

Technology

The Application features an immersive virtual reality visualization built on top of the Unity game engine. It works with common VR glasses such as the HTC Vive or the Oculus Rift.

Interaction Features

- Intuitive interactions with vertices (grabbing and moving)
- User interface for highlighting different vertex attributes
- Easy to use sliders that allow switching between different versions of a graph without loosing visual focus

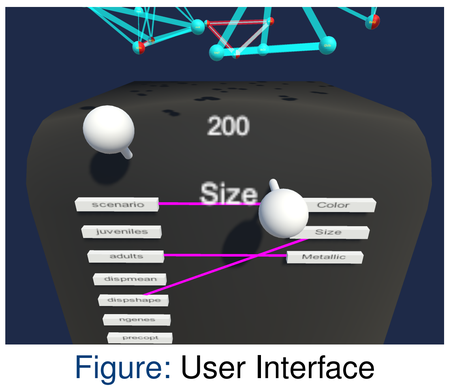

Figure: User Interface

Data

The Application uses data from an agent-based, eco-evolutionary simulation model. The model is grid-based and integrates ecological, evolutionary and environmental processes. The Data extracted from this model describes coexistence relationships between species and their ecological and evolutionary attributes over time. The vertices are placed in the scene through a spring based layout algorithm.

id	a	b	c	d	e
a	0	0	0	0	30
b	0	0	12	0	0
c	0	12	0	0	7
d	0	0	0	0	0
e	30	0	7	0	0

Table: Adjacency matrix of coexistence in one scenario. These values correspond to the edge width.

time	id	dispmean	juveniles	adults
200	a	0.681	235.757	4.272
200	b	0.902	581.657	4.057
500	a	0.578	235.500	3.500
500	b	0.793	240.714	5.603

Table: List of species attributes by timestep and vertex/species id. These can be mapped to the visual attributes of vertices, such as size or color.

Comparison

Two scenarios can be combined into a superposition view. This makes differences in coexistence relationships and vertex attributes immediately noticeable.

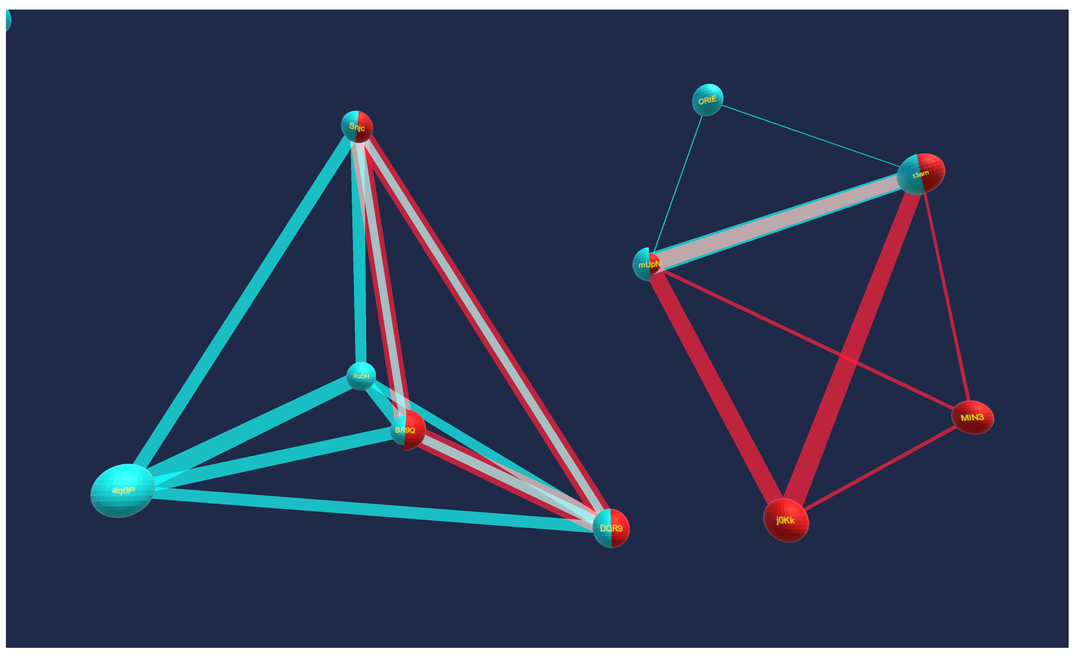

Figure: Comparing vertices and edges of different thickness shows the differences between the blue and the red scenario

Conclusion

- The Visualization provides a very good overview over the change of simulation attributes over time.
- Differences and Similarities can be viewed on a microscopic and macroscopic level.
- With some optimizations the framework could be extended to allow for the visualization of larger graphs.

Related Work

[1] Oh-Hyun Kwon, C. Muelder, Kyungwon Lee, and Kwan-Liu Ma.
A study of layout, rendering, and interaction methods for immersive graph visualization.
IEEE Transactions on Visualization and Computer Graphics, 22(7):1802–1815, July 2016.

[2] Ugo Erra, Delfina Malandrino, and Luca Pepe.
Virtual reality interfaces for interacting with three-dimensional graphs.
International Journal of Human–Computer Interaction, 35(1):75–88, January 2018.

[3] K. Andrews, M. Wohlfahrt, and G. Wurzinger.
Visual graph comparison.
In *13th International Conference Information Visualisation*, pages 62–67, July 2009.

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