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Science and Virtual Reality – Combining a scientific coral reef model with an awareness rising 3-D underwater world

Hauke Reuter[1], Andreas Kubicek, Gabriel Zachmann[2]

[1]Department Theoretical Ecology and Modelling, Leibniz-Centre for Tropical Marine Research (ZMT)., Bremen, Germany
[2]Computer Graphics Group, Department for Computer Science, University of Bremen, Germany

Tropical coral reefs, which provide major services for over 500 million people, face severe challenges, such as temperature increase causing frequent deadly bleaching events, and local impacts resulting from intensive use and pollution. Elaboration of scientific tools which allow to extrapolate reef dynamics in detail, assess impact of various drivers and thus evaluate sustainable management schemes is necessary. However, the resulting scientific knowledge often remains inaccessible for management authorities and ecosystem users. Furthermore, it is highly desirable to transfer results into the public for better understanding of underlying processes, management measures, decisions and awareness building.

To address these issues, we have developed a scientific agent-based simulation model which integrates reef components and their spatial interactions and captures reef reactions to various impacts. The model allows to project community development under different scenarios of elevated water temperature and other disturbances. The results indicate threshold for disturbances and for elevated temperature in dependence of the frequency of bleaching events. The speed of adaptation to temperature rise is decisive for survival of coral traits and the resulting community composition.

Novel visualization and gaming technologies, such as virtual-reality (VR), offer the potential to close the gap between scientifically-sound simulation models and the general public's understanding of processes, drivers, and trajectories of coral reefs. Immersing non-specialists in a virtual environment that lets users interactively experience a simulated reef like a real one will create a high degree of presence and, thus, belief in the simulation. Showing them the extrapolations of the simulation model of the reef in a time-lapse model greatly facilitates comprehension of complex forecasts even for non-experts working in political, societal, and economic sectors.

Our presentation will give an overview on how agent-based simulation models of coral reefs serve as "virtual laboratories" to analyze coral reef developments under different environmental and use conditions. We will present techniques to generate 3D virtual environments automatically in real-time based on these models, allowing for a full immersive experience. This innovative approach for underwater modeling provides an interactive and dynamic framework to test different scenarios and outcomes on reef development and, thus, will contribute to public understanding and awareness building for threats to fragile ecosystems.