Artist-directed Modeling of Competitively Growing Corals

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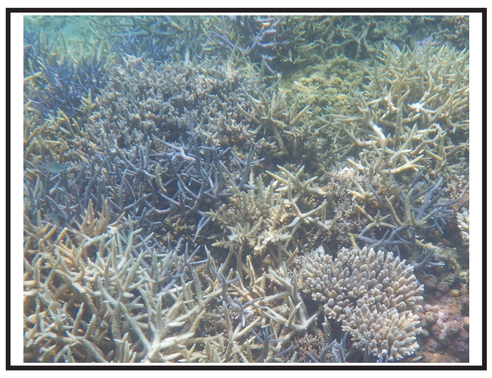
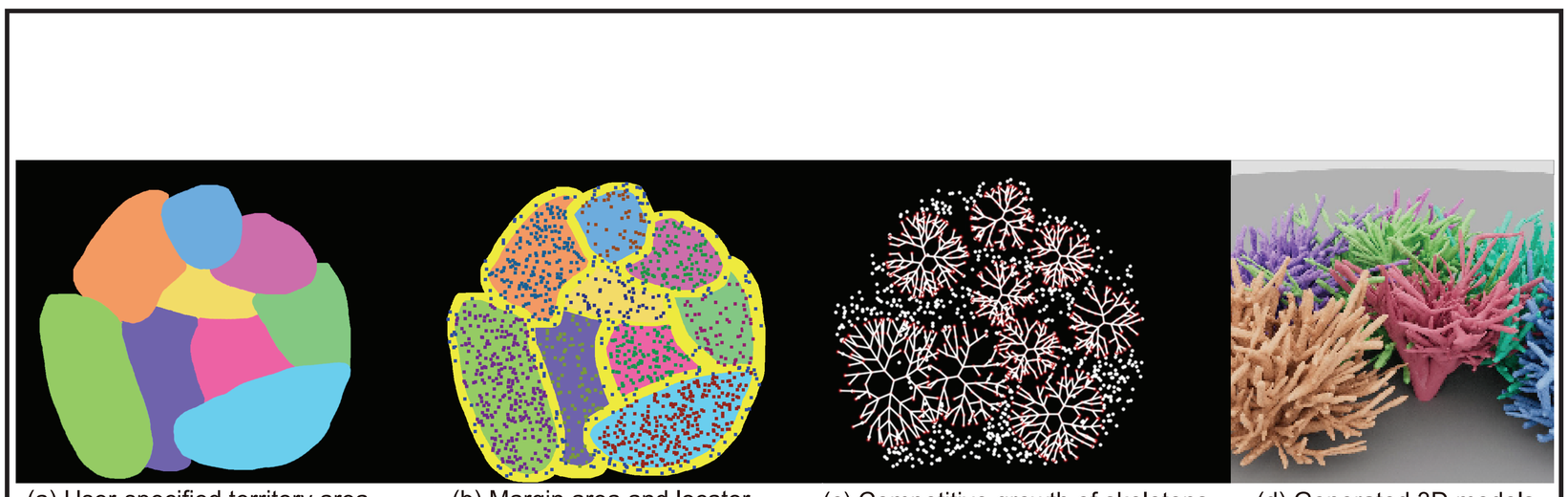
This paper presents a procedural modeling method for coral groups considering the territorial conflict between species. We developed a graphical interface to control the territorial battle by arbitrarily arranging locator points that represent available space to growth coral branches. The skeletal shapes of corals are generated according to species-specific structural rules while competing for the locators between neighboring individuals.

Introduction



Coral reefs are crucial for visual expression of warm underwater scenes. A simple approach to creating the reef scene is arranging various coral models, such as reef-building and gem corals. The rule-based modeling techniques have been applied to generate a wide variety of coral shapes with a few manual parameters. However, actual corals become entangled because of territorial disputes with other species, which is not considered in the conventional methods. We propose a system that can easily create models that more closely resemble coral ecosystem.

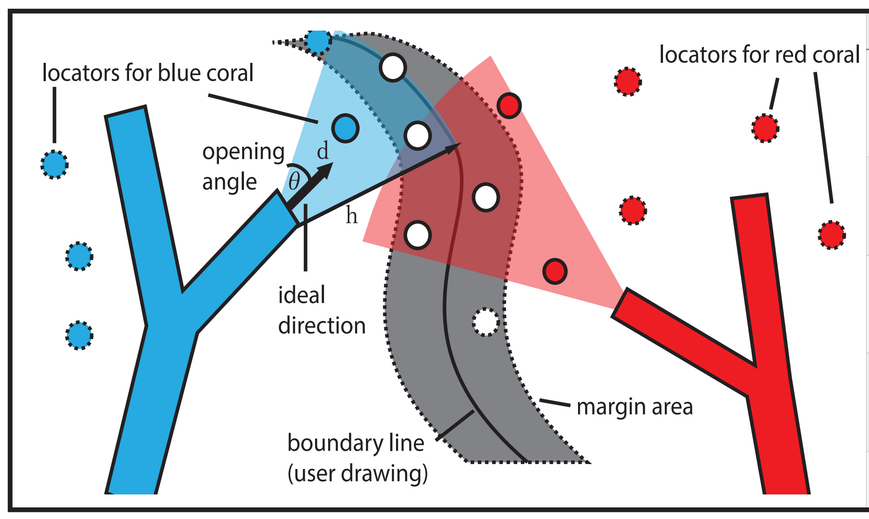
Method



(a) User-specified territory area (b) Margin area and locator (c) Competitive growth of skeletons (d) Generated 3D models

Our system provides a graphical interface for designing the coral shapes.
(a) The user roughly specifies the territory areas of each coral. (b) Locator points are arranged in each area.
(c) The skeletal structure of each coral grows based on the species-specific structural rule while competing for the locators. (d) Naturally entangled coral shapes can be designed with less special knowledge.

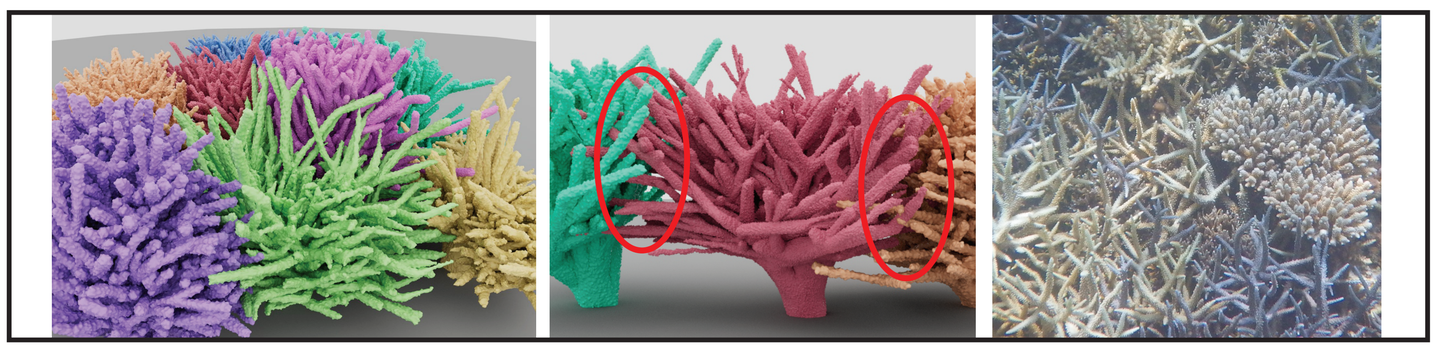
Taking the growth of two branches as an example, growth is calculated as follows. The end-tip of each branch searches locator points assigned to the individual and competes for free locators in the margin area. The ideal growing direction is determined according to the formal shape grammars of the L-system.



terms	Description
boundary line	A boundary line where the user can specify the area where the user wants to place locators.
locators	The point at which the branch is used to grow. Some belong to each coral, and some do not.
margin area	Margin area from the boundary. Unaffiliated locators are generated here.
ideal direction	Original direction of growth from parent branch.
opening angle	Angle to search for locators from ideal direction

Results

Each individual was generated with a different shape grammar. Entangled branches were naturally produced without penetrations by mimicking the territorial conflict. In particular, comparing the red circled areas in both the resulting image and the actual coral photo, we can see how the branches intertwine with each other while maintaining their own area.



Furure Work

Our future work includes the development of an intuitive interfaceto specify a volumetric locator distribution considering the coral ecosystem.

References

W. Palubicki, et al. 2009. Self-Organizing Tree Models for Image Synthesis. ACM Transactions on Graphics, 28, 3, Article 58 (2009).

Acknowledgements

This work is supported by PlatinumGames Inc.