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Towards Climate-Resilient Blue-Green Cities: Integrating AI, Machine Learning, and Synthetic Biology

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Abstract

The FIU Generative AI-SynBio Blue-Green-Structures Design Studio, led by the author, is a five-year funded global research project in different locations and climate zones. We argue that this research project supports to involves collecting and analyzing geospatial climatic data using data-driven Generative AI-ML, Generative Adversarial Networks (GAN), and Cellular Automata (CA) design methods with digital twins and surrogate modeling to fitness test and create carbon-positive and renewable energy-powered cities, buildings, and infrastructure scenarios. In addition, the research studio is exploring the integration of innovative solutions for circular metabolism and self-sufficient green-blue adaptive infrastructure modeling tools and workflows that assist adapt to climate change's impacts, such as heat waves, sea-level rise, storm surge, and resource scarcity in the low-lying Miami Island areas of Florida and in low-lying coastal areas of Genoa, Italy. The design and built research projects currently showcase some of its findings in the International Venice Architecture Biennale exhibition of the European Culture Center. This research exhibition aims to provide practical and visionary solutions to coastal cities' challenges with heat waves, rising sea levels, hurricanes and storm surges. The project also uses generative AI-assisted evolutionary algorithms with synthetic biology coding and design modeling workflows to envision carbon-positive blue-green adaptive and reconfigurable infrastructures, buildings, and cities. This cutting-edge experimental project is leading the charge, harnessing the power of Generative AI design with cellular automata growth tools and synthetic biology coding to create a more sustainable, carbon-positive, and resilient future.

Keywords: Generative AI, Machine Learning, Carbon-Positive Design, Generative Adversarial Networks, Synthetic Biology