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DEVELOPMENT OF NATURE INSPIRED ASTRONAUTIC AND AERONAUTIC TECHNOLOGY THROUGH THE PERIODIC TABLE OF LIFE (PETAL)

Abstract

Life is a methodical architect with the power to devise, improvise, and revise through millennia into eons. Humanity has long drawn inspiration from the lessons and myriad strategies that Mother Nature provides us. However, despite its natal essence to engineering, biomimetics (bionics or biomimicry) as a specialized science is still relatively neoteric. The V.I.N.E. (Virtual Interchange for Nature-inspired Exploration) team at NASA's Glenn Research Center is currently developing PeTaL (Periodic Table of Life) as a design tool to assist in the systematic discovery of nature's ingenuity to solve engineering challenges through qualitative and quantitative analytics for model construction. These models encompass the principles of paleomimesis (mimicking of earth's evolutionary past) and physio-teleology (studies concerning the purposes of life such as self-propagation and sustainment), which allow for deep time evolutionary trend observations. Here we describe data science strategies applied towards the achievement of those goals including the implementation of a modern dashboard interface for an intuitive and aesthetic user experience, as well as a flexible and scalable database system. In an evolving manner, engineering strategies associated with the mined text articles are employed to build machine learning models for classification of the text through word occurrence frequencies. Alongside machine learning based ensemble classification, prediction, clustering, and image analysis, this strategy allows for the identification of relationships between quantitative and qualitative data to associate with a biomimetic engineering ontology system. Though the PeTaL tool possesses utility for the development of a diverse range of technology applications, a particular emphasis has been placed on facilitating analytics for the development of astronautic and aeronautic related technology that is in scope with the majority of efforts conducted at the NASA Glenn Research Center.