Creative Evolutionary Design Tools

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The Emergent Design Group at MIT [1] unites architects from the School of Architecture and computer scientists from the Artificial Intelligence Lab. The architect members embrace a process of design that stresses emergence. In this process the complex aspects of an architectural scenario are studied and addressed with a bottom up methodology. Primitive level investigations pursue distinct realms such as morphology (i.e. form, shape), material, structure, program, etc., and subsequently are integrated and non-linearly combined to shape the architectural experience and artifacts that respond to the scenario.

Creativity in form is one essential thread in the process. Our architects desire computational tools that will stimulate their creativity and contribute to their creative output. In addition, they are intrigued by natural form and biological growth processes that underlie its formation. They find an organic quality to surfaces very compelling.

With these broad interests and requirements in mind, we have positioned our expanding and exploratory suite of tools [2, 3, 4, 5] at the union of two complementary computational approaches: evolutionary computation and artificial life. The evolutionary component, when present in a tool of our group, computationalizes

- population-based selection on the phenotype,
- inheritance and blind variation of the genotype, and,
- a process mapping, translating or developing the phenotype from the genotype.

The ALLife components have diverse behavior and purpose: we have used enhanced L-systems [6, 7], agent simulation [8], and simulations modeling navel world physics interacting with 'living' agents.

A useful way of describing the creative accomplishments of our suite is to trace two hereditary routes of development. One path starts at Genetic Generative Explorer, proceeds to Rule Genetic Programming and presently ends at Agency-GP. The other traces from GermZ to MoSS to GENRE. Along the way we investigated, learned and addressed various issues that arise as consequences of our trying to provide computational creative assistance using paradigms that, though fundamentally advantageous, present challenges when used in this context. Two major aspects of these challenges are

- design evaluation and,
- providing interactive, interruptible, and easily guided designer interfaces.

Concerning design evaluation, we have forgone so-called 'Interactive Evolutionary Computation (IEC)'. In IEC a tool works only with a small population of solutions that it displays for user assessment. We strongly feel this forces the search into too small a subspace and reduces the computational search potential of evolutionary algorithms. Instead, we have introduced multi-objective quantitative criteria conceptualized as 'agents'. Agents experience and evaluate a design. Each agent's assessment can be viewed for any population member and the combination of agents' assessments can be changed by the designer on-line.

We have coined the acronym 'IIR' standing for Interruption, Intervention and Resumption to describe the mode of interface our tools provide. IIR captures the notion that the creative component must be ultimately under the control of the designer. The designer starts the creative search, and then uses a variety of controls to guide the tools towards exploring designs of interest. This guiding process may be non-linear in search criteria as we presume it is an outcrop of the designer's own creative process. This assumption requires some
extensions to any evolutionary component to accommodate the on-line nature of the interaction. We also presume the designer may wish to view and manipulate any design the system generates and then integrate the outcome back into the adaptive process. This requires technical approaches to handling the mapping between genotype and phenotype.

References


