



■ cema's principle application areas

Below are the major topics of interest to CEMA staff.

electronic art

digital design

music synthesis and composition

game design and programming

CEMA projects usually involve the application of ideas based in the fields detailed in the numerous sections of this document, to these major application areas.

scientific visualization

visual effects for film and television

virtual reality

experimental interactive systems

generative & self-organizing systems

These systems exploit database amplification and emergence, in which complex large-scale outcomes arise from simple, local specifications. Examples include the emergence of group behaviour in collections of biological organisms such as social insects (bees, wasps, ants), herd, flocking and crowd interactions. These systems also specify the interactions that form the hierarchies of biology, all the way from atoms to ecosystems. Studies in Artificial Life and computational biology are all related to one another through a common interest in generative and self-organizing systems.

Research in this area might entail the implementation of models of self-assembly and the production of dynamical hierarchies. The simulation of biological phenomena also provides ample scope for inter-disciplinary study. Specific areas of interest include cellular and developmental models, reaction-diffusion systems, Cellular Automata, L-systems and grammar-based approaches to models of growth.

computational aesthetics

Problems in computational aesthetics involve the investigation of aesthetic ideas or theory through the development of software. Examples include the techniques of aesthetic evolution, granular synthesis, behavioural and agent-based animation and particle systems. Each of these ideas expanded the possibilities for computational aesthetics by allowing artists the freedom to explore territory which could not be replicated using traditional media.

Research into new techniques for computational aesthetics may take existing techniques as a basis and look to other disciplines in order to clearly demonstrate new potential for computer software as a creative medium.

history and philosophy of science and art

The established theory and criticism of art largely neglects Generative and Artificial Life art. A theory is needed which places these fields into the context of science and art generally. Theories of creativity, especially as they apply to computers and the technological manufacture of aesthetic artefacts are also needed.

Whilst the art/science dialectic has been addressed by some commentators, there remains ample scope for current theories of computer-based generative art and artificial life art with clear reference to their roots in cybernetic art, kinetic art and robotic art.

This research would need to form the basis of research into one or several of the other areas detailed in this document for it to be supervised entirely within CEMA. Candidates interested in

studying this area specifically and without a technical aspect to their study are asked to seek co-supervision within the Humanities before approaching CEMA staff as associate supervisors.

computer-based artificial life

Artificial Life is the study of biological phenomena using software models and simulations. It is a super-set of the study of generative and self-organizing systems (see above). In addition to these concerns, studies in Artificial Life may investigate the spread of disease, evolutionary stable strategies, mate-selection, game-play and competition or complete virtual creatures and worlds. Many Artificial Life simulations are agent-based. The systems studied typically operate in a "bottom-up" fashion where the researcher establishes rules of interaction amongst simple elements, in order to have them exhibit emergent, global behaviour.

Simulation of biological phenomena employing Artificial Life and agent-based models may form the basis of research which better helps us understand the principles and behaviours of the natural world. Artificial Life models may be used as a test-bed for studies which are difficult or impossible to carry out in the field. Additionally, Artificial Life provides a basis for understanding complexity in the physical world in general, in such a way that it may be applied to solving problems in areas as diverse as traffic routing and searching algorithms.

aesthetic theory + practice of interaction

Computer-human interaction has improved considerably since the days of punch cards and batch processing but much remains to be explored. Especially where aesthetic concerns dominate, the keyboard and mouse are inadequate for many applications whilst more complex and cumbersome technologies such as headsets, data-gloves and stereo screens are expensive and often over-ride the aesthetics of the experience of a work of interactive or immersive art. CEMA is interested in the development and analysis of new techniques for fluid interaction with computer software, in particular with dynamic, generative software and virtual spaces.

Research in this area could involve the development of specific software and hardware (or the development of software for use with existing hardware) for monitoring the behaviour of a human user and incorporating this into electronic generative processes.

computer graphics + animation

Computer Graphics has become a very broad field dealing with image synthesis techniques. Opposite are some areas of particular interest to CEMA staff. These have been broken into three major graphics topics that could form the basis for further research.

In each, research would take the form of qualitative or quantitative improvements to existing techniques, or the development of new methodologies which clearly broaden the possibilities for image synthesis.

modelling - implicit surfaces, physically & functionally-based modelling, biologically-inspired modelling, model synthesis algorithms (procedural modelling in general)

rendering - non-photorealistic rendering techniques, physically-based algorithms for rendering optical effects and phenomena

animation - behavioural and procedural animation, interactive animation, Artificial Intelligence & Artificial Life-based animation

■ further information...

For further information on our research, to apply for a postgraduate position* or to discuss a topic of mutual interest, please contact us - our details are provided on the [CEMA homepage](#).

We look forward to hearing from you.

* To assist us in evaluating your application for a postgraduate position, please attach a current copy of your academic record and a one-page research proposal including (i) the intended area of your research (ii) the specific research question you wish to address (iii) the proposed method of addressing the research question.

