# Interactive Evolutionary Search and Exploration Systems

## Preface

There is a history of research relating to interactive evolutionary computing (IEC) which, in the main, has concerned partial or complete human evaluation of the fitness of solutions generated from evolutionary search. This has generally been introduced where quantitative evaluation is difficult if not impossible to achieve. Early examples of application include graphic arts and animation [1,2]; automotive design [3]; food engineering [4] and database retrieval [5]. Such applications rely upon a complete subjective evaluation of the fitness by the user of a particular design, image, taste etc as opposed to an evaluation developed from some analytic model.

Partial human evaluation / interaction is also in evidence. Examples include user interaction relating to an evolutionary nurse scheduling system where a schedule model provides a quantitative evaluation of a solution. However, the model may not prove adequate in terms of changing requirements, qualitative aspects etc. In this case the user must add new constraints in order to generate solutions that are fully satisfactory [6]. A more recent partially interactive evolutionary scheduling example developed by Shackleford and Corne [7] allows the user evaluation of candidate plans in the form of Gantt charts augmented by resource usage profiles and a measure of formaliseable fitness. In the pharmaceutical industry the design of bio-molecular systems can be enhanced by partial interactive evolutionary processes where optimal bio-molecule combinations identified via evolutionary search can be improved by the user-introduction of new combinations as an elite solution into selected genetic algorithm generations [8].

Examples of recent integration of interactive evolutionary systems in engineering and industrial domains includes Carnahan and Dorris's work [9] relating to the graphical design and validation of industrial warning sign icons. Interactive EC is also evident in the development of hearing-aid signal processing capabilities where the user's evaluation of his / her hearing contributes significantly during the fitting process [10]. Caleb-Solly and Smith [11] utilize interactive evolutionary procedures in the identification of regions of interest in sets of images during real-time hot rolled steel surface inspection. Such identified regions support the classification of defects. In terms of engineering design Parmee et al [12, 13,14] propose that varying forms of interactive evolution can provide high quality information to the user which supports implicit learning, an intuitive understanding of complex interactions and an iterative improvement in design problem representation.

It is possible to view complete human evaluation as explicit interaction whereas partial evaluation and interaction could be viewed as a less explicit, more subtle degree of human involvement. Recent work involving the on-line assessment of the manner in which students navigate a web-based tutorial system [15] and the utilization of this data to optimize (via an ant colony model) the web layout to facilitate future student usage could be viewed as an implicit form of interaction as the users are unaware of their role in the evolution of the system. A spectrum of interactive evolutionary approaches can therefore be developed based upon their explicit /implicit nature as shown in figure 1. There is significant utility across this spectrum both in terms of direct utilization of IEC and in the integration of various IEC elements within suites of computer-aided design and decision-making tools in addition to further application in graphic arts and music.

More details of these various applications and recent developments can be found on the Workshop website (**http://www.ad-comtech.co.uk/Workshops.htm**) in addition to downloadable PowerPoint presentations and papers relating to a wide range of interactive evolutionary research activity. A good review of the field up to 2001 can be found in Takagi [16].

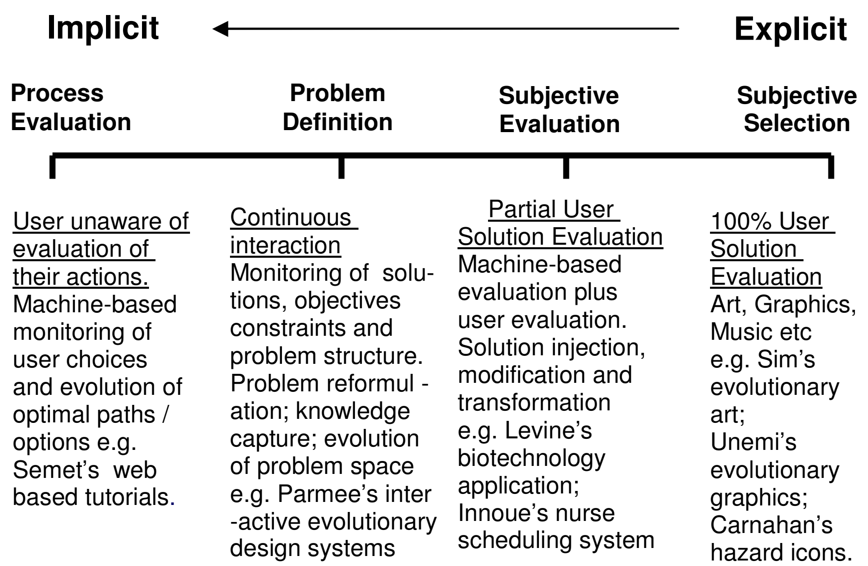


Fig 1. Possible spectrum of interactive evolutionary approaches offering utility to the designer / decision-maker.

The 2004 Workshop again comprises a diverse and interesting set of interactive evolutionary processes. The program can be found on the website and related material will be available from the website subsequent to the meeting. The nature of the workshop is speculative and discussive as opposed to results and publication oriented hence the lack of papers. However, much information is available at the Website. *Acknowledgement: Material for this preface has been largely extracted from Parmee and Abraham [17].*

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