Advancing the human experience with interactive evolutionary computation

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Advancing the Human Experience
with Interactive Evolutionary Computation

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Abstract— We first overview the research trend of computational intelligence, discuss what comes next in the computational intelligence research, and conclude that humanized technologies would be one of the essential keywords of the possible research direction. Then, we take up interactive evolutionary computation (IEC) as one of the humanized technologies and show how IEC technology has spread to a wide variety of fields, what problems remain, and what kinds of challenges need to be solved, and how to make the technology practical.
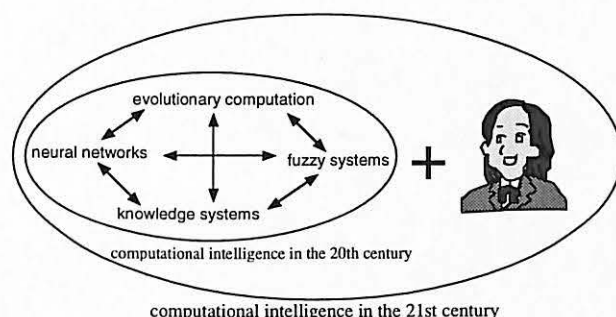
Figure 1: Computational Intelligence (CI) research from now.

1 INTRODUCTION

Looking back over the history of computational intelligence in the 20th century, especially that of so-called Soft Computing. The seeds of the neural networks, fuzzy systems, and EC were sown in the 1960s, and they were widely but independently researched during the 1980s; as research activities increased during the 1980s, interest in fusing them has also been rapidly increasing, and these cooperative technologies have widely and practically spread into commercial products and industrial systems during the 1990s [1]. Roughly speaking, 1980s was the decade of each computational intelligence technology, and 1990s was the decade of the cooperative technologies of computational intelligence technologies.

What comes next ? There are several directions where computational intelligence research could go from now. One of possible research directions would be a humanized technology where computational intelligence technologies and humans are cooperatively combined similar to the research on human factors or *KANSEI* in the 1990s (see Figure 1). One of the realized ways of the humanized technology is the IEC that combines the human evaluation capability with the computer optimization capability.

2 INTERACTIVE EVOLUTIONARY COMPUTATION AS HUMANIZED TECHNOLOGY

The IEC is an EC that optimizes systems based on subjective human evaluation. The IEC will become more important in design, adjustment, and creation that are directly related with human essential *KANSEI* factors such as preference, emotion, feeling, and so on. It is deeply expected that as the IEC is further developed, it will help unite humanized technology with user-friendly technology.

Even classic engineering technologies which did not seem to need human factors are requested to be humanized technologies, and the IEC can make the conventional technologies be humanized technologies. Let us see such examples. Intelligent robotics can measure physical environment of a robot, avoid obstacles, and control the speed and direction of the robot. But, it cannot realize preferred or gentle-mannered robot actions without human evaluation. Conventional AI tools can acquire knowledge from a database but cannot obtain qualified knowledge without expert's evaluation of the acquired knowledge. It is easy for image or sound signal processing to design a filter to maximize signal-noise ratio, the conventional signal processing cannot match the processes images or sounds with human preference without the human.

Table 1: Statistics of IEC papers by field and year. Papers that discuss more than one topic are counted in each corresponding category.

	'80s	'90	'91	'92	'93	'94	'95	'96	'97	'98	'99	2000	total
graphic art & CG animation	2		3	2	4	5	5	2	2	4	9	4	42
3-D CG lighting design								1	3	1			5
music					1	3	3	1		1	3	5	17
editorial design									1		1	2	4
industrial design				2	2	1	5	4		2	4	9	29
face image generation			1		1	1	2		1	4	5	1	16
speech processing & prosodic control							2	1	2		1	1	7
hearing aids fitting										2	7	5	14
virtual reality								1	1				2
database retrieval								2	1	8	8	1	20
knowledge acquisition & data mining							5	3	3	1	4		16
image processing									1	2			3
control & robotics				1				2		3	4	4	14
Internet										1	2	1	4
food industry								1	1				2
geophysics											1	2	3
art education												2	2
writing education										1	3		4
games and therapy								1	1	1			3
social system										1			1
discrete fitness value input method								5		2			7
prediction of fitness values							1	2	1	8	3	1	16
interface for dynamic tasks						1					1	3	5
acceleration of EC convergence								1	1	3	1		7
combination of IEC and non-IEC								1	2				3
active intervention			1								3	2	6
total	2	0	5	5	8	11	23	28	22	48	57	43	252

3 WIDE VARIETY OF IEC RESEARCH

Many papers on IEC research have been published in various fields for these 10 years [2]. There are two main research directions of IEC applications and IEC interface research.

The IEC application fields include graphic arts and animation, 3-D CG lighting, music, editorial design, industrial design, facial image generation, speech processing and synthesis, hearing aid fitting, virtual reality, media database retrieval, data mining, image processing, control and robotics, food industry, geophysics, education, entertainment, social system, and so on.

The interface research to reduce human fatigue includes improving fitness input interfaces and displays based on fitness prediction, accelerating EC convergence especially in early EC generations, examining combinations of interactive and normal EC, and investigating active user intervention.

Table 1 shows these wide varieties of the IEC research by year.

4 CONCLUSION

In this abstract paper, we try to show what research direction of computational intelligence becomes important from now and why. Humanized technology is our answer to its question, and the IEC is one of our concrete realization ways of the humanized technology.

REFERENCES

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[2] Hideyuki Takagi, "Interactive Evolutionary Computation: Fusion of the Capacities of EC Optimization and Human Evaluation," Proceedings of the IEEE (will appear in 2001).