Editorial

An outstanding platform for ground-breaking cross-disciplinary research

According to the Cambridge Dictionary, "engineering" is the study of using scientific principles to design and build machines, structures, and other things, including bridges, roads, vehicles, and buildings. Some ingenious examples of early and yet advanced engineering solutions are the automatic sliding doors powered by steam engines designed by Heron of Alexandria in the first century AD or the qanat irrigation system in Persia in the eighth century BC at the time of the Assyrian king Sargon II.

In a broad sense, engineering has been with us for millennia and is a distinctive trait of human nature. The design of engineering solutions for even relatively simple tasks very often requires the use/assistance of intermediate tools. As demonstrated in experiments on animal psychology and in particular on a famous chimpanzee called Sultan [1], while animals of other species can use tools to solve tasks they appear to be incapable to build tools to solve tasks. Thus, humans apparently are the only species able to apply a creative approach to problem solving which may involve multiple phases of planning and the construction of intermediate tools.

In modern times, a very important and widely used tool in engineering is the computer. Since its theoretical definition by Alan Turing [2], computers have undergone major changes in their hardware, e.g. in power and size, and the ways they are used. Over the past decades, computers are considered multipurpose devices that can usefully assist an engineer in their work. According to the Encyclopedia Britannica, Computer-Aided Engineering (CAE) is the *integration of design and manufacturing into a system under the direct control of digital computers*. Of course, the meaning of CAE and what a computer can do for an engineer changed over the past decades and continues to change.

Founded by a visionary, impactful and highly influential scholar of modern times, "*based on the premise that interdisciplinary thinking and synergistic collaboration of disciplines can solve complex problems, open new frontiers, and lead to true innovations and breakthroughs with a focus on the integration of leading edge and emerging computer technologies for innovative solution of engineering problems,*" as noted in the introduction to the inaugural issue of the journal published in July 1993, *Integrated Computer-Aided Engineering* (ICAE) publishes the latest research about CAE. Professor Hojjat Adeli, as the founder and Editor-in-Chief of ICAE, led the evolution of CAE while shaping the subject and anticipating its coming trends.

ICAE is a forum of outstanding quality that has the reputation of being a top journal in Computer Science and Engineering. For example, ICAE has been consistently for many years in the first Quartile according to the Web of Science in the categories of *Computer Science, Artificial Intelligence*, and *Computer Science Interdisciplinary Applications*.

Professor Adeli achieved this extraordinary result thanks to his meticulous and rigorous hard work. Every submission must be accompanied by the statement that "*it is original unpublished work and the manuscript or any variation of it has not been submitted to another publication previously.*" Also, the prospective authors are requested to submit the list of the most impactful researchers in the same field of the submitted manuscript to verify their awareness of the latest developments and leaders in the field. The review process of each manuscript is handled with impeccable rigor by Professor Adeli. Each paper is reviewed by at least five expert reviewers. Some of these reviewers are authors of other papers submitted to ICAE while the other reviewers are selected from the *Society of ICAE* created by Professor Adeli over the past three decades. This society

is a group of trusted senior academics who agreed to serve as reviewers of ICAE by filing the *Conscientious Reviewer* form, a concept created by Professor Adeli.

Professor Adeli is an outstanding eclectic scientist who over the past forty years generated hundreds of groundbreaking contributions to CAE and drove many capital innovations. These contributions, since the very early stages of Professor Adeli's career have been both methodological and real-world orientated in various fields of computer science, engineering, mathematics, and medicine. ASCE journal of *Leadership and Management in Engineering* profiled Professor Adeli as *Engineering Legend* in 2010 and devoted an extensive article to his life story and extraordinary professional achievements [3].

For nearly three decades of ICAE under Professor Adeli's leadership, one can see, throughout the articles published therein, how CAE evolved in theory and industrial applications. The storyline narrated by the articles in ICAE tells us how the role of computers in engineering, science, and in our society changed. While thirty years ago computers were mostly tools to help engineers to solve a problem, today computers are embedded within the project and in some sense solve the problems themselves.

Some of the early articles in ICAE offer a view of computers as simulation and design environments for engineers to facilitate their work [4]. At the same time, some other early articles pushed visionary concepts and contributed to the development of Artificial Intelligence (AI) within CAE [5]. Over the following years, one may observe a transition of the role of AI in CAE: AI progressively replaced the human in decision making and became a reliable assistant that carried most of the design work leaving to the human the role of double checking the attained results. This transition is by far not straightforward and each of its steps requires the development of novel theoretical methodologies [6] and domain-specific modules [7]. More modern articles propose progressively more sophisticated frameworks where AI takes an increasingly important role within the engineering design. These studies do not tackle the engineering problems directly. They focus on AI design to solve engineering problems. Some representative examples of this trend include security/safety systems for autonomously driven vehicle [8] and image processing systems for recognising handwritten text [9].

Although we (humans) have not yet been able to design "true" machine intelligence that can fully re-place a human engineer, scientists are often striving to achieve this. The most recent articles published in ICAE con-firm this scientific challenge. In many mod-ern papers the computer, with its AI, is presented as an actor expected to solve the engineering task under consideration. Among the plethora of studies, some examples are in an autonomous health monitoring sys-tem [10], intelligent navigation systems [11], automatic design platforms for mechatronic devices [12] and Internet of Things [13].

I am certain that ICAE will continue to be a leading forum for cross-disciplinary research at the intersection of multiple fields including engineering, mathematics, computer science, and medicine to host future trends and ground-breaking contributions in CAE.

Ferrante Neri
COL Laboratory, School of Computer Science,
University of Nottingham, United Kingdom
E-mail: ferrante.neri@nottingham.ac.uk

References

[1] Ruiz G. Wolfgang kohler's the mentality of apes and the animal psychology of his time. The Spanish Journal of Psychology. 2014 10; 17: 1–25.

[2] Turing AM. On computable numbers, with an application to the entscheidungsproblem. Proceedings of the London Mathematical Society. 1937; 2(42): 230–265.

[3] Weingardt RG. Engineering legends: Hojjat adeli. Leadership and Management in Engineering. 2012; 10(2).

[4] Magleby SP, Gunn KB, Sorensen CD. Service-oriented inte-gration environment for CAD/CAM systems. Integrated Computer-Aided Eng. 1993; 1(2): 157–166.

[5] Adeli H, Hung SL. Fuzzy neural network learning model for image recognition. Integr Comput Aided Eng. 1993; 1(1): 43–55.

[6] Annunziato M, Bruni C, Lucchetti M, Pizzuti S. Ar-tificial life approach for continuous optimisation of non-stationary dynamical systems. Integr Comput Aided Eng. 2003; 10(2): 111–125.

[7] Voyles RM, Khosla PK. A multi-agent system for program-ming robots by human demonstration. Integr Comput Aided Eng. 2001; 8(1): 59–67.

[8] Bostelman R, Hong T, Madhavan R. Obstacle detection us-ing a time-of-flight range camera for automated guided vehicle safety and navigation. Integr Comput Aided Eng. 2005; 12(3): 237–249.

[9] Sanchez' A, Mello CAB, Suarez' PD, Lopes A. Automatic line and word segmentation applied to densely line-skewed historical handwritten document images. Integr Comput Aided Eng. 2011; 18(2): 125–142.

[10] Villar JR, Chira C, Sedano J, Gonzalez' S, Trejo JM. A hybrid intelligent recognition system for the early detection of strokes. Integr Comput Aided Eng. 2015; 22(3): 215–227.

[11] Zhu Z, Xiao J, Li J, Wang F, Zhang Q. Global path planning of wheeled robots using multi-objective memetic algorithms. Integr Comput Aided Eng. 2015; 22(4): 387–404.

[12] Zheng C, Eynard B, Qin X, Li J, Bai J, Gomes S, et al. A requirement-driven architecture definition approach for conceptual design of mechatronic systems. Integr Comput Aided Eng. 2019; 26(4): 361–382.

[13] Sabri L, Bouznad S, Fiorini SR, Chibani A, Prestes E, Amirat Y. An integrated semantic framework for designing context-aware internet of robotic things systems. Integr Comput Aided Eng. 2018; 25(2): 137–156.