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Editorial

Advances in architectural, engineering and construction informatics

It becomes more and more evident that traditional engineering computing techniques for the construction industry, such as numerical analysis and computer assisted drafting have limitations in supporting engineering designers in their decision making processes. Quite often newly researched and developed techniques are not practical because they are bound by computational and human-cognitive limits. Consequently, despite the benefits these new techniques may promise, practitioners have to revert back to non-computational, experienced-based, and intuitive decision making routines time after time. To address these issues the European Group for Intelligent Computing in Engineering (e.g.-ice) was founded in 1993 with the goal of making computer supported engineering methods more reliable, spontaneous and creative. Since its inception, the e.g.-ice has been bringing together experienced scientists with new (doctoral) researchers to continuously introduce new talent to the field. To our delight, in the last years, we have seen exponentially growing interest in the field, expressed by a series of recently published special issues in this journal [1,2].

To support its mission and discuss the latest developments in the field, the e.g.-ice has always organized small and focused annual workshops around a single session. This special issue collects a number of select papers that were presented at the latest workshop in the series, organized in June 2011 at the University of Twente in the Netherlands. To ensure the quality of the special issue, these select papers were significantly extended and then subjected to a thorough review process with multiple rounds of review and revision.

Through this relentless effort of both the authors and the reviewers, the papers in this special issue provide a comprehensive overview of current leading-edge research efforts in most areas of intelligent computing for supporting decision making tasks of the architectural, engineering, and construction industry. The papers have been arranged according to the general stages of the industry's design and delivery process:

1. initial physical design of several possible alternatives for a new facility,
2. simulation of the alternatives according to various criteria,
3. comparison and evaluation of the simulation results,
4. development of plans on how to best construct a chosen alternative, and
5. final control and management of the construction activities up to the time the facility is delivered.

Unfortunately, this special issue has no contribution about the final management of delivered facilities which might be another fruitful direction for future research. To guide the reader through this special issue, a short summary of each paper is provided below:

- *Geyer* kicks off the special issue with introducing a method for supporting *systems modeling for sustainable building design* [3]. The method proposes a reference process and ontology for developing design alternatives that enable streamlined evaluations of building designs with respect to energy efficiency. The paper illustrates how computer supported tools can help designers in systematically developing different alternatives for a building in the form of models that allow performance-based evaluation and comparison.
- *Kneidl et al.* developed a novel method for *generating sparse navigation graphs for microscopic pedestrian simulation* [4]. Their paper serves as an example of how new intelligent ways of simulating behavior of persons in and around facilities can support designers. The described method allows explicitly modeling of the knowledge of specific pedestrians about their environment. Such modeling, in turn, supports evaluating how different types of pedestrians will be able to navigate.
- *Slusarczyk et al.* focus on supporting the physical arrangement of spaces within a building by providing *visual languages for representing multi-storey buildings* [5]. To this end, the authors implemented the developed visual languages in a design support tool that allows designers to understand the relationship between different spaces in a building together with the overall physical configuration of the building.
- *Hofmeyer and Smulders* develop an interesting application of how computing methods can help switching between different models used for engineering design decision making [6]. In the paper, they present a two-way method for switching between the *spatial representation* required to understand a building's lay-out and the abstracted *structural representation* required for analyzing its structural behavior. With this method, Hofmeyer and Smulders work towards an integrated design process that allows for quick evaluations of the structural behavior of different spatial design alternatives.
- *Songmao and Ruqian* use the example of ancient Chinese architecture to describe how intuitive design heuristics that grew traditionally over centuries can be logically captured and used to automate design tasks [7]. The developed *intelligent computer-aided ancient architecture design (ICA3D)* system is an illustration of how advanced engineering informatics can support and automate recurring design tasks for which relative standard rules and heuristics are known.

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- *Mela et al.* the authors of the final design-related paper of the special issue, then compare different algorithms for supporting *multi-criteria decision making methods* [8]. As most of the above summarized papers show, computing techniques can be used to quickly develop more design alternatives and evaluate these alternatives according to more criteria than is possible in non-computerized design practice. Therefore, establishing ways of meaningfully choosing between the large number of alternatives according to many, often conflicting, criteria becomes more and more important. Mela et al. provide an overview of possible systematic methods for making such choices and illustrate the applicability of the described methods on a number of scenarios.
- *Benevolenskiy et al.* focus on supporting planning and controlling of construction activities using *construction process configuration patterns* [9]. While construction processes are usually depicted as rather unique and not repetitive, there is still large knowledge existing about different generally applicable production methods. Often, however, due to unique local site conditions and organizational resources, construction planners have to adjust these methods to specific project contexts. Benevolenskiy et al. present a method for not only capturing generalizable knowledge about production methods, but also for adjusting these generalized methods to specific construction projects.
- *Ning et al.* present a *genetic algorithm-based method for look-ahead scheduling* for organizing construction tasks for the finishing phase of building construction [10]. The algorithm shows the potential of using optimization methods to streamline repetitive work tasks across several locations using the example of room-finishing activities for offices.
- *Akhavian and Behzadan* close the special issue with a paper that takes computing technologies beyond the initial planning stage of a facility into the realm of *remote monitoring and planning of construction operations* [11]. The paper presents an initial method for continuously updating the assumptions of *a priori* developed simulations with data collected during the execution of the activities in the field. This allows to continuously adjust previously made plans with data collected about ongoing construction processes.

After revisiting this collection of papers again for writing this editorial, I believe that this special issue provides a comprehensive overview about the state of the art in intelligent computing for supporting the architectural, engineering, and construction industry. Therefore, I hope that it will become a valuable reference source inspiring researchers to contribute to the knowledge base and practice of engineering computing in the future.

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