March/April 2017

SUTDWORKS

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A regular update featuring works by SUTD Faculty, Researchers, Students and Research Centres/Labs.
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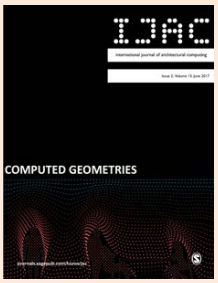
ARCHITECTURE



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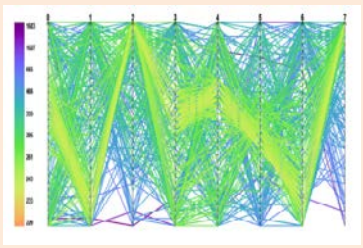
Tamke, M., Özkar, M., **Tunçer, B.,** Gattegno, N., & Peters, B. (2017). IJAC 2017: Special ACADIA edited issue. *International Journal Of Architectural Computing,* 15(1), 3-5.

This special issue detailed how design with data-integrated methods, such as parametric design, performance simulation and digital fabrication, influences the field of architecture. Three main points are addressed in this issue. Firstly, how designers were able to move away from analysis of real-world data into modes of designing. Secondly, the impact algorithmic processes, data integration and digital fabrication have on architectural design. Thirdly, opportunities for theoretical design hinged upon data input and feedback are addressed.

ARCHITECTURE – DESIGN SPACE



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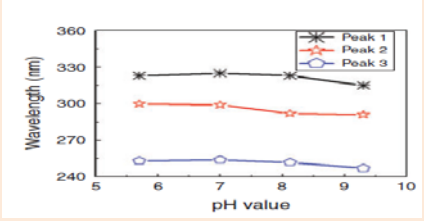
Wortmann, T. (2017). Surveying design spaces with performance maps: A multivariate visualization method for parametric design and architectural design optimization. *International Journal Of Architectural Computing,* 15(1), 38-53.

A technique that visualizes high-dimensional parametric design spaces was developed. Computational design processes and interactive optimization are potential areas in which it could be used. By enabling architects to shift between a high-dimensional design space and a low-dimensional Performance Map, it helps in comprehending issues in architectural design optimization. In the Performance Map, one can see the main landscape aspects. The Performance Map also helps architects see links between performance and design parameters.

CHEMISTRY – BORON SENSOR



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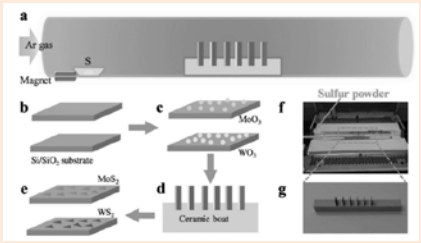
Chen, F., Ai, Y., & Yang, H. (2017). Boron detection and quantification based on the absorption spectra of pyridoxine and its boron complex. *Environmental Chemistry*, 14(3), 135-140

The researchers presented a technique, hinged upon the optical behavior of pyroxidine or a boron-pyroxidine complex, which detects boron species in aqueous samples. The absorption intensity of the boron–pyridoxine complex was directly proportional to the concentration of boron in the sample. The boron concentration was inversely proportional to that of free pyridoxine. This technique can be used for both freshwater and seawater samples, as its accuracy is relatively unaffected by ions often present in water.

CHEMISTRY – VAPOR-DEPOSITION



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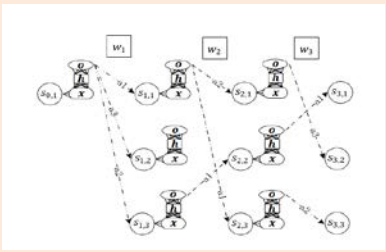
Sun, L., Leong, W., Yang, H.Y., Chisholm, M., **Liang, S.,** & **Ang, L.** et al. (2017). Concurrent Synthesis of High-Performance Monolayer Transition Metal Disulfides. *Advanced Functional Materials*, 27(15), 1605896-1-8.

Transition metal dichalcogenides (TMDs) have traditionally been synthesized using chemical vapor deposition (CVD). However, existing CVD techniques are unable to synthesize multiple kinds of TMDs simultaneously. This prompted the authors to establish a CVD method that was capable of synthesizing multiple monolayer TMDs simultaneously. This method indicates that there will be widespread batch production of 2D TMDs in the future.

COMPUTER SCIENCE – ARTIFICIAL INTELLIGIENCE



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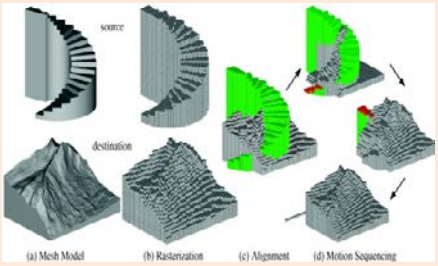
Zhou, H., **Zhang, Y.,** Cheng, C., Huang, S., Dai, X. & Chen, J. (2017). A Neural Probabilistic Structured-Prediction Method for Transition-Based Natural Language Processing. *Journal of Artificial Intelligence Research,* 58, 703-729.

A neural probabilistic structured-prediction technique for natural language processing was designed. This technique combines both beam search and contrastive learning. Heuristic decoding can be accomplished more methodically using beam search. Contrastive learning is performed for adjusting the model according to search errors.

CONSTRUCTION & BUILDING – PROCESS SEQUENCING



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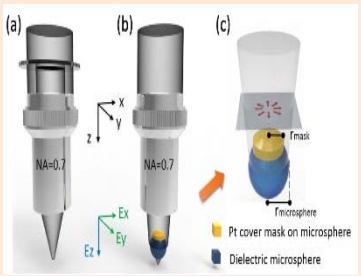
Pan, W., Chen, L., & Dritsas, S. (2017). Pick-and-place process sequencing for transformation of rasterized 3D structures. *Automation in Construction,* 75, 56-64.

In this research, the authors devised an enhanced method for process sequencing in automated assembly of three-dimensional structures, commonly found in large-scale construction. This process may be applied in application-dependent scenarios, such as crane operations and large scale 3D printing.

OPTICS – RADIAL POLARIZATION



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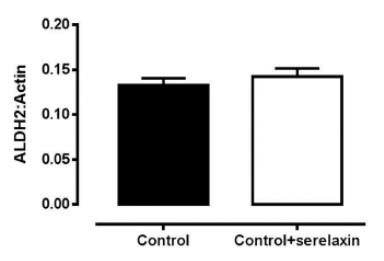
Wu, M., Chen, R., **Ling, J., Chen, Z.,** Chen, X., Ji, R., & Hong, M. (2017). Creation of a longitudinally polarized photonic nanojet via an engineered microsphere. *Optics Letters,* 42(7), 1444-1-4.

In this research, the authors used engineered structures to alter the surface of dielectric microsphere and this resulted in high beam quality of a longitudinally polarized electromagnetic component. Through varying how the engineered microspheres were formed, it was able to efficiently vary the longitudinal and radial components of a radially polarized incident beam, to produce a clearly defined spot over the optical diffraction limit.

PHARMACOLOGY



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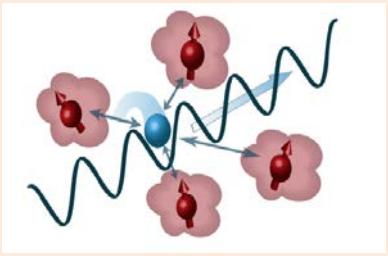
Leo, C., Fernando, D., Tran, L., Ng, H., Marshall, S., & Parry, L. (2017). Serelaxin Treatment Reduces Oxidative Stress and Increases Aldehyde Dehydrogenase-2 to Attenuate Nitrate Tolerance. *Frontiers In Pharmacology*, 8.

For patients with heart failure, glyceryl trinitrate (GTN) is often prescribed. However, significant tolerance to long-term GTN treatment, seemingly leads to higher oxidative stress and limits expression of aldehyde dehydrogenase-2 (ALDH-2). Thus the researchers carried out tests on rodents to determine if treatment with serelaxin reduced tolerance brought about by treatment with GTN. It was discovered that combining serelaxin with GTN led to reduced GTN tolerance as oxidative stress was reduced and ALDH-2 expression was increased in the rat aorta.

PHYSICS – FUIDS & PLASMAS



Read More

Teo, C., Bissbort, U., & Poletti, D. (2017). Converting heat into directed transport on a tilted lattice. *Physical Review E*, 95(3), 030102-1-6.

Read about a self-contained engine, which comprises of at least one system of two levels. Each one of the systems is connected to a common load involving a particle on a tilted lattice and a single bath. It was illustrated that when the bath interacts with the system, there was an increase in entropy and energy of the system due to energy splitting of particle spins. This increase in system energy and entropy led to the particle moving upward with its speed invariant. In an ensemble of different spins, it was shown that the particle had higher velocity if the tilt of the lattice was in resonance with energy splitting of at least one spin.

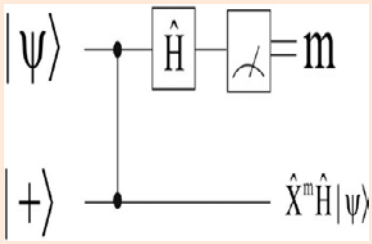
ROBOTICS –
ROBOT-ASSISTED THERAPY

Read More

Bharatharaj, J., Huang, L., **Mohan, R. E.**, Al-Jumaily, A., & Krägeloh, C. (2017). Robot-Assisted Therapy for Learning and Social Interaction of Children with Autism Spectrum Disorder. *Robotics,* 6(1), 4.

The researchers presented a potential adapted model-rival method (AMRM) using a parrot-inspired robot to perform indirect teaching to children with autism spectrum disorder. It was found that the robot had the potential simulate the children to interact positively with it and help improve in their learning and social interaction.

SCIENCE & TECNOLOGY –
CONTROLLED COLLISIONS



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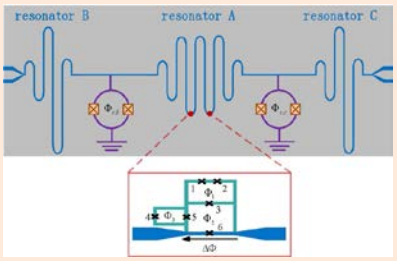
Mantri, A., Demarie, T. F., & Fitzsimons, J. F. (2017). Universality of quantum computation with cluster states and (X, Y)-plane measurements. *Scientific Reports*, 7, 42861.

The researchers affirmed that the requirement for Z measurements, which are found in measurement-based quantum computing (MBQC), can be dropped while maintaining universality. Unlike previous works, the authors proved universality in a new way which avoids the need to remove qubits.

SCIENCE & TECNOLOGY –
SUPERCONDUCTING



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Wang, Y., **Guo, C.,** Zhang, G., Wang, G., & **Wu, C.** (2017). Ultrafast quantum computation in ultrastrongly coupled circuit QED systems. *Scientific Reports,* 7, 44251-1-8.

Circuit quantum electrodynamics (QED) systems are part of quantum computing. In this research, a strategy was presented to accelerate the two-qubit phase gate in a circuit QED system. Multiple transmission line resonators were used by the researchers to produced a radically faster quantum gate in the absence of ultrastrong coupling.