SINGAPORE UNIVERSITY OF TECHNOLOGY AND DESIGN

12 December 2020 – 12 February 2021

TOPICAL REPORT

DIGITAL DESIGN & FABRICATION

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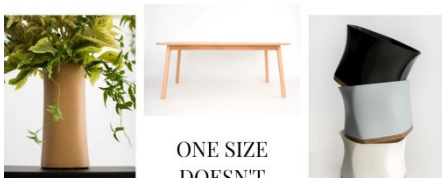
news

3D PRINTING



The future of making stuff: Inside the evolution of 3D printing with Formlabs

"When 3D printing went mainstream in the mid-2010s and exploded in popularity, it was about as hyped up as it possibly could be. Evangelists told us it would fundamentally transform the way goods were made, and usher in a bold new era of creative freedom. Soon, they said, we'd be able to fabricate anything we wanted on-demand, Star Trek replicator style, right from the comfort of our own homes."
Source: Digital Trends

NASA Successfully Tests 3D Printed Rocket Engine Parts

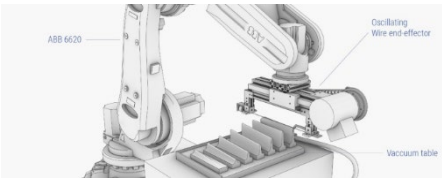
"The high-strength iron-nickel superalloy nozzle was printed using laser powder directed energy deposition (DED), one of NASA's advanced manufacturing methods that will improve the performance and reduce the production costs of rocket thrust chamber assemblies, and was demonstrated in NASA's Rapid and Analysis Manufacturing Propulsion Technology (RAMPT) project."
Source: 3DPrint.com

WASP Finishes 3d Printing Sustainable Biomaterial-Based 'Tecla' Eco-Habitat

"Nicknamed 'TECLA,' the fully-fabricated dwelling has been built

academic

ROBOTIC FABRICATION



Oscillating wire cutting and robotic assembly of bespoke acoustic tile systems

"This paper presents a novel method for digital production of bespoke ceramic assemblies for spatial acoustic modulation, demonstrating a hybrid robotic process combining robotic oscillating wire cutting (ROWC) of wet clay bricks and adaptive pick and place (APnP) production of bespoke brick panel assemblies. These processes are carried out within the framework of a deployable robot cell that can be shipped to a jobsite where complex fabrication and assembly can be performed in situ."
Source: Construction Robotics

Robotic Training for the Integration of Material Performances in Timber Manufacturing

"With a specific focus on timber subtractive manufacturing, the work presented in this thesis addresses the main issue hindering the utilisation of non-standard tools and heterogeneous materials in design processes which is the significant deviation between what is prescribed in the digital design environment and the respective fabrication outcome. To begin, it has been demonstrated the extent to which the heterogeneous properties of timber affect the outcome of the robotic

reports

ADDITIVE MANUFACTURING

3d Printing Industry Year In Review

"The month of March 2020 saw the publication of additive manufacturing safety standards, new 3D printing materials qualified, innovative biomaterial discoveries, and even plans to 3D print explosives. Read on for the standout developments of March 2020, which involved the likes of ASTM International, ExOne, Wohlers Associates, Siemens, Stratasys, Relativity Space, and the UK Defense Agency."
Source: 3D Printing Industry

using multiple systems at once, with each depositing natural materials into a unique supporting structure. The novel additive habitat, which was designed by Italian firm Mario Cucinella Architects, has been erected as a proof-of-concept, and a blueprint for a new sustainable housing model."
Source: 3DPrintingIndustry

New Singapore Law Criminalizes Possession of Blueprints for 3D Printing Guns

"Singapore moved to control digital blueprints for 3D printing guns or major gun parts, like barrels or trigger mechanisms. On January 5, 2021, Parliament passed a new Guns, Explosives, and Weapons Control Bill that would make illegal the ownership of digital blueprints of a gun or gun parts without a license."
Source: 3DPrint.com

Circular Economy Under-explored in 3D Printing, Say Researchers

"Researchers from UNIDEMI at the Universidade NOVA de Lisboa in Portugal took note of the fact that, while 3D printing could serve as a key technology in a circular economy, there is not yet significant discussion of this possibility in the additive manufacturing (AM) industry."
Source: 3DPrint.com

DIGITAL DESIGN

These Are The Digital Design Trends To Watch In 2021

"From immersive web formats to whimsical face filters and warm, optimistic color palettes, experts say the year will be full of surprises."
Source: Builtin

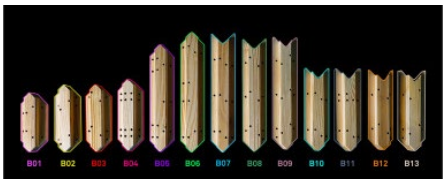
Computational Design, with Bernhard Thomaszewski

"Lilly interviews Bernhard Thomaszewski, Professor of Computer Science at the University of Montréal and research scientist at ETH Zurich. Thomaszewski discusses his background in animation at Disney, his current work on mechanical metamaterials and digital fabrication, and how physics-based modeling has connected the dots."
Source: Robohub

The Tech to Expect in 2021—and the Impact of 2020

"The 12 forward-thinking architects and designers below highlight an increasing array of remote work tools; carving process beyond the acceptable tolerance thresholds for design purposes."
Source: University College of London

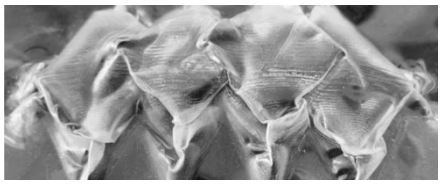
TIMBER FABRICATION



Design and assembly automation of the Robotic Reversible Timber Beam

"This paper presents an original workflow for the automation from design to layered robotic assembly of reversible timber structures, aided by human-robot collaboration. An advanced digital design workflow for non-standard timber structures is established, shifting the focus towards the assembly of a kit of discrete wood elements into larger configurations that can be reconfigured in time."
Source: Automation in Construction

DIGITAL DESIGN



Fabrication grammars: bridging design and robotics to control emergent material expressions

"This paper argues that such expressions can be executed by a domain-driven feedback paradigm, which integrates a human-in-the-loop to encode the tacit fabrication knowledge that is generated by reviewing intermediate outcomes. We encode this tacit knowledge by fabrication grammars, rule-based descriptions that causally relate fabrication parameters to qualitative descriptions of material expressions. By documenting a set of Single Point Incremental Forming experiments, this paper demonstrates how emergent material expressions can be controlled by semantically meaningful fabrication grammars, which even can be combined towards purposeful design goals."
Source: Construction Robotics

Design framework for a seamless smart glove using a digital knitting system

"In this study, a digital knitting CAD/CAM system is utilized to meet the desired performance criteria, and two prototypes of the seamless glove sensor systems are successfully developed for the detection of both

virtual, augmented, and mixed reality platforms; and crossover capabilities from the gaming world. And, notably, the question arises of whether these new capabilities are making design more accessible and accountable to underserved populations."
Source: ArchitectMagazine

ARCHITECTURAL FABRICATION

RAW architecture uses recycled plastic + bamboo for workshop and residence in indonesia

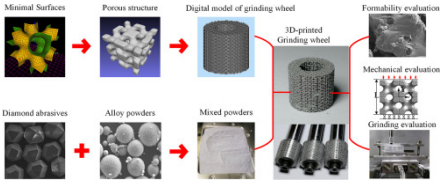
"the residence is contained within a circular, three-story building with a 3 x 3 m footprint. designed by RAW architecture for a single family, the program includes two kid's bedrooms, one master bedroom, and shared bathrooms. the openable building envelope is constructed using recycled plastic panels that cover and protect the inner bamboo structure."
Source: Design Boom

human and robotic finger motions. This digital knitting system will provide considerable potential for customized design development as well as a sustainable production process. This structured, systematic approach could be adapted in the future development of wearable electronic textile systems."
Source: Fashion and Textiles

Digital Fabrication: an Outlook from Digital Tectonics

"This work seeks to identify the relationships between digital manufacturing technologies and the different views about the tectonic component of architecture. To accomplish so, we have reviewed recent research that encompasses these concepts and their processes and
methodologies of project design, instrumental and theoretical development, through which an analysis of these two aspects of current architectural practice can be identified and proposed."
Source: Sigradi

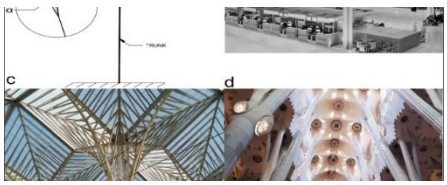
3D PRINTING



Digital design and performance evaluation of porous metal-bonded grinding wheels based on minimal surface and 3D printing

"The formability is investigated for 3D-printed binder-abrasive composite and 3D-printed wheel porous structure. The mechanical properties of wheel porous structure are evaluated based on experiment and finite element method. The grinding performance of 3D-printed grinding wheel is evaluated and compared to the electroplated wheel."
Source: Materials & Design

ARCHITECTURE FABRICATION



The design and construction vision of concrete arch structure using modern technologies

"This article deals with the vision of design and construction of an arch structure using modern technologies

(such as BIM, parametric and generative design, digital fabrication etc.). Transition to these methods can lead to facilitation and process acceleration or safety and efficiency improvement. Due to used technologies (robotization and prefabrication) and construction progress, an optimization of default shape was needed. A genetic algorithm was selected for its versatility and efficiency to optimize the initial shape. The whole algorithm (including finite element method analysis) was compiled in Python language. At the end, the results of optimization are introduced along with advantages and disadvantages of such an approach."
Source: AIP Conference Proceedings 2322

Integrating reinforcement in digital fabrication with concrete: A review and classification framework

"This article offers a comprehensive, systematic overview of the existing solutions for integrating reinforcement in digital concrete technologies with particular emphasis on Additive Manufacturing (AM) with concrete, also called 3D concrete printing (3DCP). While the functionalities of various types of reinforcement are briefly addressed, the major focus is on the integration process as such, i.e., on its technological aspects."
Source: Cement and Concrete Composites

A Generalizable Gridshell

"This thesis is about increasing access to light-weight structures using wood that is readily available and can be fabricated with a 7-axis industrial robot. Thus, it proposes an open-source system which integrates material and robotic fabrication knowledge into a parametric design process, all created in one single digital design-to-fabrication environment."
Source: The University of British Columbia