**1**

**Control of process settings for large-scale additive manufacturing with sustainable natural composites [Texto impreso] / Yadunund Vijay, Naresh D. Sanandiya, Stylianos Dritsas, Javier G. Fernandez**

Este artículo se encuentra disponible en su edición impresa y electrónica. Los datos para su localización están accesibles a través del enlace al título de la publicación. Su acceso electrónico es a través del enlace de 'Acceso al documento'.
References: p. 081701(12)

We present a system for 3D printing large-scale objects using natural biocomposite materials, which comprises a precision extruder mounted on an industrial six-axis robot. This paper highlights work on controlling process settings to print filaments of desired dimensions while constraining the operating point to a region of maximum tensile strength and minimum shrinkage. Response surface models relating the process settings to the geometric and physical properties of extruded filaments are obtained through face-centered central composite designed experiments. Unlike traditional applications of this technique that identify a fixed operating point, the models are used to uncover dimensions of filaments obtainable within the operating boundaries of our system. Process-setting predictions are then made through multi-objective optimization of the models. An interesting outcome of this study is the ability to produce filaments of different shrinkage and tensile strength properties by solely changing process settings. As a follow-up, we identify optimal lateral overlap and interlayer spacing parameters to define toolpaths to print structures. If unoptimized, the material's anisotropic shrinkage and nonlinear compression characteristics cause severe delamination, cross-sectional tapering, and warpage. Finally, we show the linear scalability of the shrinkage model in 3D space, which allows for suitable toolpath compensation to improve the dimensional accuracy of printed artifacts. We believe this first-ever study on the parametrization of the large-scale additive manufacture technique with biocomposites will serve as reference for future sustainable developments in manufacturing.

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**2**

**Design and transmission error analysis of CBR reducer [Texto impreso] / Xiaoxiao Sun, Liang Han, Jian Wang**

Este artículo se encuentra disponible en su edición impresa y electrónica. Los datos para su localización están accesibles a través del enlace al título de la publicación. Su acceso electrónico es a través del enlace de 'Acceso al documento'.
References: p. 082301(9-10)

A new one-stage type cycloid drive reducer named China Bearing Reducer (CBR) is designed and its tooth contact analysis is investigated. First, the CAD model is built in SolidWorks and the structure of CBR reducer is introduced. Its advantages and disadvantages are compared with rotor vector (RV) reducer and harmonic drive reducer. Second, the mathematic model of cycloid profile and modified cycloid profile are established based on gear meshing and differential geometry, and the tooth shapes of three different modifications are compared with CBR25 reducer. Third, the conventional TCA method is described and a new TCA method by using discretized points is proposed to calculate transmission error and contact force of cycloid drive. Both the methods are used to compute the unloaded transmission error of CBR25 reducer to compare the computational efficiency. Finally, three different modified methods of tooth profile are investigated by using the new TCA method to calculate transmission error and contact force of CBR25 reducer, and the results show that the negative isometric and negative offset modified method is best for CBR25 reducer to reduce transmission error and contact force. The prototype of CBR25 reducer is manufactured and the transmission error and hysteresis curve are measured by using a testing bench. The results show that the new TCA method can be used to calculate transmission error and help better design the CBR reducer.

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**3**

**Managing sociotechnical complexity in engineering design projects [Texto impreso] / Mohammad Hassannezhad, Marco Cantamessa, Francesca Montagna, P. John Clarkson**

Este artículo se encuentra disponible en su edición impresa y electrónica. Los datos para su localización están accesibles a través del enlace al título de la publicación. Su acceso electrónico es a través del enlace de 'Acceso al documento'.
References: p. 081101(17)

Design project management is witnessing an increasing need for practitioners to rely on tools that reflect the integrated nature of the social and technical characteristics of design processes, as opposed to considering the two as separate concepts. For practitioners, this integration has the potential value of predicting the future behavior of design processes by allowing them to understand what task to do next, whom to assign a task given the availability of resource, and the levels of knowledge and expertise required. In response to these challenges, this paper contributes to the development of a new process modeling method, called actor-based signposting (ABS), that looks at the early stages of the product development processes from the perspective of integrated sociotechnical systems. The objective is to support managers and decision-makers on both typical planning issues, such as scheduling and resource allocation, and less conventional issues relating to the organizational planning of a design project, such as identification of criticalities, matching required skills and expertise, and factors of influence. Ultimately, the aim is to support organizations to be more adaptive in responding to change and uncertainty. Two case studies in the automotive and aerospace industries with different properties and modeling objectives were selected to demonstrate the utility of the proposed method. Experimental analysis of these cases led to a range of insights regarding the future of modeling for academia as well as the decision-making capabilities for managers and practitioners.

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**4**
**A moving morphable voids approach for topology optimization with closed B-splines [Texto impreso] / Bingxiao Du, Wen Yao, Yong Zhao, Xiaoqian Chen**

Este artículo se encuentra disponible en su edición impresa y electrónica. Los datos para su localización están accesibles a través del enlace al título de la publicación. Su acceso electrónico es a través del enlace de 'Acceso al documento'.
References: p. 081401(12-13)

Topology optimization with moving morphable voids (MMVs) is studied in this paper. B-spline curves are used to represent the boundaries of MMVs in the structure. Kreisselmeier–Steinhauser (KS)-function is also implemented to preserve the smoothness of the structural boundary in case the intersection of the curves happen. In order to study the influence of continuity, we propose pseudo-periodic closed B-splines (PCBSs) to construct curves with an arbitrary degree. The selection of PCBS parameters, especially the degree of B-spline, is studied and discussed. The classic Messerschmitt–Bolkow–Blohm (MBB) case is taken as an example in the numerical experiment. Results show that with the proper choice of B-spline degrees and number of control points, PCBSs have enough flexibility and stability to represent the optimized material distribution. We further reveal the mechanism of the merging process of holes and find that high-order degree PCBS could preserve more separated voids. A support beam design problem of microsatellite is also studied as an example to demonstrate the capability of the proposed method.

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1. Closed B-spline 2. Moving morphable components 3. Moving morphable voids 4. Topology optimization

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**5**
**Optimal flow control and single split architecture exploration for fluid-based thermal management [Texto impreso] / Satya R. T. Peddada ... [et al.]**

Este artículo se encuentra disponible en su edición impresa y electrónica. Los datos para su localización están accesibles a través del enlace al título de la publicación. Su acceso electrónico es a través del enlace de 'Acceso al documento'.
References: p. 083401(11-12)

High-performance cooling is often necessary for thermal management of high power density systems. However, human intuition and experience may not be adequate to identify optimal thermal management designs as systems increase in size and complexity. This article presents an architecture exploration framework for a class of single-phase cooling systems. This class is specified as architectures with multiple cold plates in series or parallel and a

single fluid split and junction. Candidate architectures are represented using labeled rooted tree graphs. Dynamic models are automatically generated from these trees using a graph-based thermal modeling framework. Optimal performance is determined by solving an appropriate fluid flow distribution problem, handling temperature constraints in the presence of exogenous heat loads. Rigorous case studies are performed in simulation, with components subject to heterogeneous heat loads and temperature constraints. Results include optimization of thermal endurance for an enumerated set of 4051 architectures. The framework is also applied to identify cooling system architectures capable of steady-state operation under a given loading.

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**6**

**Optimum design of serial robots [Texto impreso] / Vinay Gupta, Subir Kumar Saha, Himanshu Chaudhary**

Este artículo se encuentra disponible en su edición impresa y electrónica. Los datos para su localización están accesibles a través del enlace al título de la publicación. Su acceso electrónico es a través del enlace de 'Acceso al documento'.
References: p. 082303(11-12)

An optimum design of an industrial robot can be achieved from different point of views. For example, a robot can be conceived from the standpoint achieving maximum workspace or minimum weight, etc. In this paper, the objective is to arrive at a robot design that will require optimum driving torques/forces at its joints to perform tasks within its workspace. Such a design will automatically save energy. Note that these torques/forces at the joints are highly dependent on the mass and the inertia properties of the robot's links. Therefore, these quantities were minimized by determining the optimum masses and optimum mass centers and finding out the corresponding inertia properties of the moving links. Such an approach was briefly introduced earlier by the authors with the help of a simple two-link planar arm. In this paper, the concept is generalized and demonstrated with the help of a complex robot, a 6-degrees-of-freedom PUMA robot. To achieve the design for optimum driving torques/forces at the joints, the concept of equimomental system of point masses was introduced, which helped to obtain the optimum locations of the mass centers of each link quite conveniently. However, to compute the driving torques/forces recursively for such equivalent point mass systems, the decoupled natural orthogonal complement matrices for point masses (DeNOC-P) was derived. It has led to a simplified algorithm for obtaining driving torques/forces. The proposed algorithm for optimization is illustrated with the help of a PUMA robot.

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**7**

**Pneumatic soft arm based on spiral balloon weaving and shape memory polymer backbone [Texto impreso] / Jianbin Liu ... [et al.]**

Este artículo se encuentra disponible en su edición impresa y electrónica. Los datos para su localización están accesibles a través del enlace al título de la publicación. Su acceso electrónico es a través del enlace de 'Acceso al documento'.
References: p. 082302(12-13)

This paper presents a novel design of soft arm with triplet spiral balloons weaving and a shape memory polymer (SMP) backbone mechanism, which enables dexterous actuation and an additional variable stiffness function. The soft arm is aimed for assisting minimally invasive surgery (MIS). The triplet spiral balloons, which are actuated by pressure air, are woven helically around the SMP backbone, covered by a rubber sheath. This structure gives the soft arm a wide range of actuation, which allows it to reach the target without damaging surrounding tissues blocking its way. The SMP backbone, whose stiffness changes with the temperature, gives the arm the ability of shape holding. Temperature control of the SMP backbone is realized by the electric wire and cooling channels. A prototype is manufactured and a set of experiments is conducted with the aim of assessing the performance of variable stiffness and actuation. The effects of different loads and pressures on trajectory of the arm are evaluated together with the force-deflection curves. The prototype has also been validated with abdominal phantom, demonstrating the potential clinical value of the system.

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**8**

**A step toward fault type and severity characterization in spur gears [Texto impreso] / I. Dadon, N. Koren, R. Klein, J. Bortman**

Este artículo se encuentra disponible en su edición impresa y electrónica. Los datos para su localización están accesibles a través del enlace al título de la publicación. Su acceso electrónico es a través del enlace de 'Acceso al documento'.
References: p. 083301(11)

Gear transmissions are widely used in industrial applications and are considered to be critical components. To date, the capabilities of gear condition indicators are controversial as some condition indicators can diagnose one type of fault at the early stages, yet cannot diagnose other types of faults. This study focused on fault detection and characterization based on vibrations in a spur gear transmission. Three different common local faults were examined: tooth face fault, broken tooth, and cracks at the tooth root. The faults were thoroughly analyzed to understand the fault manifestation in the vibration signature and to find condition indicators that are robust and sensitive to the existence and severity of the fault. The analysis was based on both experimental data and simulated signals from a well-established dynamic model of the gear system. The fault detection capability of common condition indicators, as well as newly defined condition indicators, was examined and measured using statistical distances. For each fault type, the investigated condition indicators were categorized according to their discrimination power between faulted and healthy states and the ability to rank the fault severity. It was concluded that faults that affect the involute profile throughout the tooth are easily detectable. Faults such as root cracks or chipped tooth, in which mainly the tooth stiffness is affected, are much more challenging to detect. It has been shown that while using a realistic model, the capabilities of different condition indicators can be tested, and the experiments can be replaced by simulations.

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1. Condition monitoring 2. Gear dynamic model 3. Gear fault diagnostics 4. Signal processing 5. Vibration analysis

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**9**

**Wisdom of microcrowds in evaluating solutions to esoteric engineering problems [Texto impreso] / Nurcan Gecer Ulu ... [et al.]**

Este artículo se encuentra disponible en su edición impresa y electrónica. Los datos para su localización están accesibles a través del enlace al título de la publicación. Su acceso electrónico es a través del enlace de 'Acceso al documento'.
References: p. 081102(9-10)

A multitude of studies in economics, psychology, political and social sciences have demonstrated the wisdom of crowds (WoC) phenomenon, where the collective estimate of a group can be more accurate than estimates of individuals. While WoC is observable in such domains where the participating individuals have experience or familiarity with the question at hand, it remains unclear how effective WoC is for domains that traditionally require deep expertise or sophisticated computational models to estimate objective answers. This work explores how effective WoC is for engineering design problems that are esoteric in nature, that is, problems (1) whose solutions traditionally require expertise and specialized knowledge, (2) where access to experts can be costly or infeasible, and (3) in which previous WoC studies with the general population have been shown to be highly ineffective. The main hypothesis in this work is that in the absence of experts, WoC can be observed in groups that consist of practitioners who are defined to have a base familiarity with the problems in question but not necessarily domain experts. As a way to emulate commonly encountered engineering problem-solving scenarios, this work studies WoC with practitioners that form microcrowds consisting of 5–15 individuals, thereby giving rise to the term the wisdom of microcrowds (WoMC). Our studies on design evaluations show that WoMC produces results whose mean is in the 80th percentile or better across varying crowd sizes, even for problems that are highly nonintuitive in nature.

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