1

Examining the influence of solar panel installers on design innovation and market penetration [Texto impreso] / Ekaterina Sinitskaya ... [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. 041702(14)

This work uses an agent-based model to examine how installers of photovoltaic (PV) panels influence panel design and the success of residential solar energy. It provides a novel approach to modeling intermediary stakeholder influence on product design, focusing on installer decisions instead of the typical foci of the final customer (homeowners) and the designer/manufacturer. Installers restrict homeowner choice to a subset of all panel options available, and, consequentially, determine medium-term market dynamics in terms of quantity and design specifications of panel installations. This model investigates installer profit-maximization strategies of exploring new panel designs offered by manufacturers (a risk-seeking strategy) versus exploiting market-tested technology (a risk-averse strategy). Manufacturer design decisions and homeowner purchase decisions are modeled. Realistic details provided from installer and homeowner interviews are included. For example, installers must estimate panel reliability instead of trusting manufacturer statistics, and homeowners make purchase decisions based in part on installer reputation. We find that installers pursue new and more-efficient panels over sticking-with market-tested technology under a variety of panel-reliability scenarios and two different state scenarios (California and Massachusetts). Results indicate that it does not matter if installers are predisposed to an exploration or exploitation strategy—both types choose to explore new panels that have higher efficiency.

Journal of mechanical design. -- 2019 (April), v. 141, n. 4, p. 041702(1-14)

2

The complete set of one-degree-of-freedom planetary gear trains with up to nine links [Texto impreso] / Wenjian Yang, Huafeng Ding

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. 043301(21-22)

The structural synthesis of planetary gear trains (PGTs) is helpful for innovating transmission systems in machinery. A great deal of research has been devoted to the synthesis of one-degree-of-freedom (1-DOF) PGTs over the past half century. However, most synthesis methods are limited to PGTs with no more than eight links. Moreover, the synthesis results are not consistent with each other. Until now, the inconsistency of synthesis results is still unresolved and exact synthesis results remain elusive. This paper presents a systematic and fully automatic method based on parent graphs to synthesize 1-DOF PGTs. The complete database of rotation graphs (r-graphs) and displacement graphs (d-graphs) of 1-DOF PGTs with up to nine links is established for the first time. All possible reasons for the contradictory synthesis results in the literature are analyzed and the controversy in the existing synthesis results which has lasted for nearly half a century is completely resolved. The exact results of the 6-, 7-, and 8-link r-graphs are confirmed to be 27, 152, and 1070, respectively. The exact results of the 6-, 7-, and 8-link d-graphs are confirmed to be 81, 647, and 6360, respectively. Additionally, the new results of 8654 r-graphs and 71,837 d-graphs of 9-link PGTs are provided for the first time.

Journal of mechanical design. -- 2019 (April), v. 141, n. 4, p. 043301(1-22)
1. Displacement graph 2. Parent graph 3. Planetary gear train 4. Rotation graph 5. Structural synthesis

---

3

Design heuristics for additive manufacturing validated through a user study [Texto impreso] / Alexandra Blösch-Paidosh, Kristina Shea

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. 041101(8)

Additive manufacturing (AM) has unique capabilities when compared to traditional manufacturing, such as shape, hierarchical, functional, and material complexity, a fact that has fascinated those in research, industry, and the media for the last decade. Consequently, designers would like to know how they can incorporate AM's special capabilities into their designs but are often at a loss as how to do so. Design for additive manufacturing (DfAM) methods are currently in development, but the vast majority of existing methods are not tailored to the needs and knowledge of designers in the early stages of the design process. Therefore, we propose a set of process-independent design heuristics for AM aimed at transferring the high-level knowledge necessary for reasoning about functions, configurations, and parts to designers. Twenty-nine design heuristics for AM are derived from 275 AM artifacts. An experiment is designed to test their efficacy in the context of a redesign scenario with novice designers. The heuristics are found to positively influence the designs generated by the novice designers and are found to be more effective at communicating DfAM concepts in the early phases of redesign than a lecture on DfAM alone. Future research is planned to validate the impact with expert designers and in original design scenarios.

Journal of mechanical design. -- 2019 (April), v. 141, n. 4, p. 041101(1-8)

4

Discovering sequenced origami folding through nonlinear mechanics and topology optimization [Texto impreso] / Andrew S. Gillman, Kazuko Fuchi, Philip R. Buskohl

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. 041401(10-11)

Origami folding provides a novel method to transform two-dimensional (2D) sheets into complex functional structures. However, the enormity of the foldable design space necessitates development of algorithms to efficiently discover new origami fold patterns with specific performance objectives. To address this challenge, this work combines a recently developed efficient modified truss finite element model with a ground structure-based topology optimization framework. A nonlinear mechanics model is required to model the sequenced motion and large folding common in the actuation of origami structures. These highly nonlinear motions limit the ability to define convex objective functions, and parallelizable evolutionary optimization algorithms for traversing nonconvex origami design problems are developed and considered. The ability of this framework to discover fold topologies that maximize targeted actuation is verified for the well-known “Chomper” and “Square Twist” patterns. A simple twist-based design is also discovered using the verified framework. Through these case studies, the role of critical points and bifurcations emanating from sequenced deformation mechanisms (including interplay of folding, facet bending, and stretching) on design optimization is analyzed. In addition, the performance of both gradient and evolutionary optimization algorithms are explored, and genetic algorithms (GAs) consistently yield solutions with better performance given the apparent nonconvexity of the response-design space.

Journal of mechanical design. -- 2019 (April), v. 141, n. 4, p. 041401(1-11)

5

Dynamic analysis of planar mechanisms with fuzzy joint clearance and random geometry [Texto impreso] / Dongyang Sun, Yan Shi, Baoqiang Zhang

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. 042301(8-9)

The dynamic characteristics of planar mechanisms with fuzzy joint clearance and random geometry are studied in this paper. The dynamics model for the mechanism is constructed by utilizing Baumgarte approach in which the clearance size is a fuzzy number, while the geometry parameters are assumed as random variables. A hybrid contact force model, which consists of the Lankarani–Nikravesh model, improved Winkler elastic foundation model and modified Coulomb friction force model, is applied to construct revolute clearance joint. In order to solve the dynamics model, two methodologies are developed: confidence region method for quantification of random and fuzzy uncertainties (CRMQRFU) and confidence region method with transformation method (CRMTM). In the CRMQRFU, fuzzy numbers are first decomposed into intervals under the given membership level. Then, a general framework is proposed for quantification of random and interval uncertainties in the mechanism. In the CRMTM, a transformation method is applied to transform intervals into deterministic arrays, while probability

theory is used to obtain the confidence regions under the given fuzzy values. The confidence region, considering random and fuzzy uncertainties, is obtained by fuzzy set theory. Finally, two examples are used to demonstrate the validity and feasibility of these methods.

Journal of mechanical design. -- 2019 (April), v. 141, n. 4, p. 042301(1-9)
1. Clearance 2. Fuzzy uncertainty 3. Random Uncertainty 4. Transformation method

---

6
Employing knowledge on causal relationship to assist multidisciplinary design optimization [Texto impreso] / Di Wu, Eric Coatanea, G. Gary 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. 041402(11)

With the increasing design dimensionality, it is more difficult to solve multidisciplinary design optimization (MDO) problems. Many MDO decomposition strategies have been developed to reduce the dimensionality. Those strategies consider the design problem as a black-box function. However, practitioners usually have certain knowledge of their problem. In this paper, a method leveraging causal graph and qualitative analysis is developed to reduce the dimensionality of the MDO problem by systematically modeling and incorporating the knowledge about the design problem into optimization. Causal graph is created to show the input–output relationships between variables. A qualitative analysis algorithm using design structure matrix (DSM) is developed to automatically find the variables whose values can be determined without resorting to optimization. According to the impact of variables, an MDO problem is divided into two subproblems, the optimization problem with respect to the most important variables, and the other with variables of lower importance. The novel method is used to solve a power converter design problem and an aircraft concept design problem, and the results show that by incorporating knowledge in form of causal relationship, the optimization efficiency is significantly improved.

Journal of mechanical design. -- 2019 (April), v. 141, n. 4, p. 041402(1-11)
1. Casual graph 2. Dimension reduction 3. Dimensional analysis 4. Multidisciplinary design optimization

---

7
A novel region-division-based tolerance design method for a large number of discrete elements distributed on a large surface [Texto impreso] / Guodong Sa, Zhenyu Liu, Chan Qiu, Jianrong Tan

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. 041701(17-18)

The array structure is widely used in precise electronic products such as large phased array antennas and large optical telescopes, the main components of which are a large surface base and a large number of high-precision discrete elements mounted on the surface base. The geometric error of discrete elements is inevitable in the manufacturing process and will seriously degrade the product performance. To deal with the tolerance design of discrete elements, a region-division-based tolerance design method is proposed in this paper. The whole array was divided into several regions by our method and the tolerance of discrete elements was correlated with the region importance on the performance. The method specifically includes the following steps: first, the sensitivity of the product performance to geometric errors was analyzed and the statistical relationship between the performance and geometric errors was established. Then, based on the sensitivity matrix, the regional division scheme was developed, and the corresponding tolerance was optimized according to the established relationship function. Finally, the optimal tolerance was selected among the multiple solutions to achieve the best performance. Taking a large phased array as an example, a simulation experiment was performed to verify the effectiveness of the proposed method.

Journal of mechanical design. -- 2019 (April), v. 141, n. 4, p. 041701(1-18)

8

The prototype for X framework [Texto impreso] : assessing impact on self-reported prototyping behavior of student designers / Jessica Menold, Kathryn Jablokow, Timothy Simpson

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. 042001(11-12)

A significant gap exists between engineering students' perceptions of prototypes and prototyping abilities and professionals' perceptions and abilities. Structured prototyping frameworks have recently been developed and proposed as a means to help students close this gap, but the effects of these frameworks on students' behavior have not been assessed. The purpose of this work is to investigate if and how a structured prototyping framework affects the self-reported prototyping behaviors of engineering students. Understanding how structured prototyping frameworks affect students can provide educators with a deeper understanding of the way their students adopt and understand design methods. A mixed method study is presented. A 15-item survey and two open-ended questions were distributed to 235 students in a junior-level mechanical engineering design class in order to capture self-reported prototyping behavior. Quantitative results indicate that significant differences in engineering students' prototyping behaviors exist across time and between groups. Results from qualitative analysis indicate that students in the control group focused solely on improving technical quality, while students in both experimental groups focused on a wider range of design qualities. This study is the first to demonstrate that a structured prototyping framework can affect engineering students' self-reported prototyping behaviors during design activities.

Journal of mechanical design. -- 2019 (April), v. 141, n. 4, p. 042001(1-12)

9

System reliability-based design optimization under tradeoff between reduction of sampling uncertainty and design shift [Texto impreso] / Sangjune Bae, Nam H. Kim, Seung-gyo Jang

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. 041403(10)

This paper presents a tradeoff between shifting design and controlling sampling uncertainty in system reliability-based design optimization (RBDO) using the Bayesian network. The sampling uncertainty is caused by a finite number of samples used in calculating the reliability of a component, and it propagates to the system reliability. A conservative failure probability is utilized to consider sampling uncertainty. In this paper, the sensitivity of a conservative system failure probability is derived with respect to the design change and the number of samples in a component using Bayesian network along with global sensitivity analysis (GSA). In the sensitivity analysis, GSA is used for local sensitivity calculation. The numerical results show that sampling uncertainty can significantly affect the conservative system reliability and needs to be controlled to achieve the desired level of system reliability. Numerical examples show that both shifting design and reducing sampling uncertainty are crucial in the system RBDO.

Journal of mechanical design. -- 2019 (April), v. 141, n. 4, p. 041403(1-10)
1. Bayesian network 2. Epistemic uncertainty 3. Global sensitivity analysis 4. Reliability-based design optimization

---