Período

2019/07/01 - 2019/12/31

Publicaciones de alto impacto

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Número 6

Universidad de los Andes

Universidad de los Andes | Vigilada Mineducación
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1. Ali Hassan Shabbir, Jiquan Zhang, Xingpeng Liu, James A. Lutz, Carlos Valencia and James D. Johnston (2019). "Determining the sensitivity of grassland area burned to climate variation in Xilingol, China, with an autoregressive distributed lag approach". International Journal of Wildland Fire. Vol. 28, Núm.8, pp. 628-639. DOI: http://www.publish.csiro.au/wf/WF18171

2. Sepideh Abolghasem, Mehdi Toloo, Santiago Amézquita (2019). "A dataset of healthcare systems for cross-efficiency evaluation in the presence of flexible measure". Data in brief. Vol. 25, Article Number 104239. DOI: https://www.sciencedirect.com/science/article/pii/S2352340919305931?via%3Dihub

3. Díaz Juan, Cortés María, Hernández Juan, Clavijo Óscar, Ardila Carlos, Cabrales Sergio. (2019). "Index fund optimization using a hybrid model: genetic algorithm and mixed-integer nonlinear programming". Engineering Economist . Vol. 64, Núm 3, pp. 298-309.
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4. Brent A. Langellier PhD, MA; Usama Bilal MD, MPH, PhD; Felipe Montes PhD; José D. Meisel PhD; Letícia de Oliveira Cardoso PhD; Ross A. Hammond PhD (2019). "Complex Systems Approaches to Diet: A Systematic Review". American Journal of Preventive Medicine. Vol. 57, Núm. 2, pp. 273–281.
DOI: https://www.sciencedirect.com/science/article/pii/S0749379719301680?via%3Dihub

5. John E. Fontecha, Oscar O. Guaje, Daniel Duque, Raha Akhavan-Tabatabaei, Juan P. Rodríguez, Andrés L. Medaglia (2019). "Combined maintenance and routing optimization for large-scale sewage cleaning". Annals of Operations Research. -.
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6. Sefair, Jorge A.; Espinosa, Mónica; Behrentz, Eduardo & Medaglia, Andrés L. (2019). "Optimization model for urban air quality policy design: A case study in Latin America". Computers, Environment and Urban Systems. Vol. 78, Núm UNSP 101385.
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7. Juan Camilo Osorio-Pinzón, Sepideh Abolghasem, Juan Pablo Casas-Rodríguez (2019). "Predicting the Johnson Cook constitutive model constants using temperature rise distribution in plane strain machining". International Journal of Advanced Manufacturing Technology. Vol. 105, Issue 1–4, pp. 279–294 . DOI: https://link.springer.com/article/10.1007%2Fs00170-019-04225-9

8. Pérez-Suárez Andrés F., Cabrales Sergio, Amaya-Gómez Rafael, Muñoz Felipe. (2019). "Model for optimal sectioning of hydrocarbon transportation pipelines by minimization of the expected economic losses". Loss Prevention in the Process Industries . Vol. 62, Article Number 103939.
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9. Xize Wang, Daniel A. Rodríguez, Olga L. Sarmiento, Oscar Guaje (2019). "Commute patterns and depression: Evidence from eleven Latin American cities". Transport and Health. Vol. 14, Article Number 100607. DOI: https://www.sciencedirect.com/science/article/pii/S2214140518306169?via%3Dihub

10. Duque, Daniel & Medaglia, Andrés L. (2019). "An exact method for a class of robust shortest path problems with scenarios". Networks. Vol. 74, Núm. 4, pp.360-373.
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11. Juan Sebastián Hernández, Carlos Valencia, Nicolás Ratkovich, Carlos F. Torres, Felipe Muñoz (2019). "Data driven methodology for model selection in flow pattern prediction". Heliyon. Vol. 5, Issue 11, November 2019, e02718. DOI: https://www.sciencedirect.com/science/article/pii/S2405844019363789?via%3DihubDoi: 10.1002/net.21747

12. Carlos Montenegro, Sepideh Abolghasem, Juan Camilo Osorio-Pinzón, Juan Pablo Casas-Rodríguez (2019). "Microstructure prediction in low and high strain deformation of Al6063 using artificial neural network and finite element simulation". International Journal of Advanced Manufacturing Technology. pp.1-17. DOI: https://link.springer.com/article/10.1007%2Fs00170-019-04704-z

Determining the sensitivity of grassland area burned to climate variation in Xilingol, China, with an autoregressive distributed lag approach

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Carlos Valencia;
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Determining the sensitivity of grassland area burned to climate variation in Xilingol, China, with an autoregressive distributed lag approach

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Abstract. We examined the relationship between climate variables and grassland area burned in Xilingol, China, from 2001 to 2014 using an autoregressive distributed lag (ARDL) model, and describe the application of this econometric method to studies of climate influences on wildland fire. We show that there is a stationary linear combination of non-stationary climate time series (cointegration) that can be used to reliably estimate the influence of different climate signals on area burned. Our model shows a strong relationship between maximum temperature and grassland area burned. Mean monthly wind speed and monthly hours of sunlight were also strongly associated with area burned, whereas minimum temperature and precipitation were not. Some climate variables like wind speed had significant immediate effects on area burned, the strength of which varied over the 2001–14 observation period (in econometrics terms, a 'short-run' effect). The relationship between temperature and area burned exhibited a steady-state or 'long-run' relationship. We analysed three different periods (2001–05, 2006–10 and 2011–14) to illustrate how the effects of climate on area burned vary over time. These results should be helpful in estimating the potential impact of changing climate on the eastern Eurasian Steppe.

Additional keywords: ARDL model, climate change, climate sensitivity, grassland fire.

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Introduction

Changing climate and land-use practices have had a significant impact on the productivity, community composition, structure and function of many terrestrial ecosystems (Mooney *et al.* 2009; Kipling *et al.* 2016; Zhang *et al.* 2016). Changes to ecosystem structure and function as a result of disturbance are more difficult to predict than directional climate change. An understanding of the sensitivity of grasslands – lands dominated by grasses as opposed to trees or shrubs – to climate-mediated changes such as fire is especially important because grasslands are one of the most spatially extensive vegetation types in the world, accounting for ~25% of the global land surface. Changes to grasslands could have global implications for resource cycling and carbon sequestration (Yang *et al.* 2016).

Anthropogenically derived activities are important drivers of grassland degradation, especially in developing countries (Yang *et al.* 2005; Verón *et al.* 2006; Bliege Bird *et al.* 2016; Gowlett 2016). Some studies have attributed grassland degradation to temperature increases and changes in precipitation seasonality (Ravi *et al.* 2010; Yeganeh *et al.* 2014), whereas other studies report that it may be difficult to differentiate between causal factors (Wessels *et al.* 2007; Gang *et al.* 2014). Less attention has been focused on fire-mediated change, and few studies have quantified the relationship between climate variability and fire extent in grasslands at large spatial scales (Zheng *et al.* 2006; Wessels *et al.* 2008).

Fire regimes of grasslands and forests have been analysed at multiple temporal and spatial scales (Abatzoglou and

A dataset of healthcare systems for cross-efficiency evaluation in the presence of flexible measure

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Data Article

A dataset of healthcare systems for cross-efficiency evaluation in the presence of flexible measure

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ABSTRACT

This article presents the dataset of the healthcare systems indicators of 120 countries during 2010–2017, which is related to the research article "Cross-efficiency evaluation in the presence of flexible measures with an application to healthcare systems" [1]. The data is collected from the World Bank and selected for the 120 countries. Depending on their role in the performance of the healthcare systems, the indicators are categorized into input (I), output (O) and flexible measure (FM) where the FM measure can play either role of input or output in the healthcare system. The dataset can be used to perform efficiency as well as cross-efficiency analysis of the healthcare systems using methods such as data envelopment analysis (DEA) in the presence of flexible measure.

1. Data

The data comprises various indicators of the healthcare systems in 120 countries which are selected according to their availability of the data in the World Bank [2] during 2010–2017. The distribution of

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Index fund optimization using a hybrid model: genetic algorithm and mixed-integer nonlinear programming

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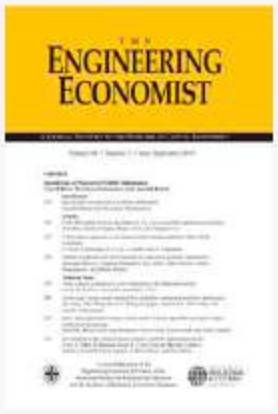

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Index fund optimization using a hybrid model: genetic algorithm and mixed-integer nonlinear programming

Juan Díaz, María Cortés, Juan Hernández, Óscar Clavijo, Carlos Ardila & Sergio Cabrales

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Complex Systems Approachesto Diet: A Systematic Review

17/07/2019

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REVIEW ARTICLE

Complex Systems Approaches to Diet: A Systematic Review

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Context: Complex systems approaches can help to elucidate mechanisms that shape population-level patterns in diet and inform policy approaches. This study reports results of a structured review of key design elements and methods used by existing complex systems models of diet.

Evidence acquisition: The authors conducted systematic searches of the PubMed, Web of Science, and LILACS databases between May and September 2018 to identify peer-reviewed manuscripts that used agent-based models or system dynamics models to explore diet. Searches occurred between November 2017 and May 2018. The authors extracted relevant data regarding each study's diet and nutrition outcomes; use of data for parameterization, calibration, and validation; results; and generated insights. The literature search adhered to PRISMA guidelines.

Evidence synthesis: Twenty-two agent-based model studies and five system dynamics model studies met the inclusion criteria. Mechanistic studies explored neighborhood- (e.g., residential segregation), interpersonal- (e.g., social influence) and individual-level (e.g., heuristics that guide food purchasing decisions) mechanisms that influence diet. Policy-oriented studies examined policies related to food pricing, the food environment, advertising, nutrition labels, and social norms. Most studies used empirical data to inform values of key parameters; studies varied in their approaches to calibration and validation.

Conclusions: Opportunities remain to advance the state of the science of complex systems approaches to diet and nutrition. These include using models to better understand mechanisms driving population-level diet, increasing use of models for policy decision support, and leveraging the wide availability of epidemiologic and policy evaluation data to improve model validation.
Am J Prev Med 2019;57(2):273–281.

CONTEXT

Complex systems methods like agent-based models (ABMs) and system dynamics models (SDMs) are well suited for examining patterns in diet and nutrition and can help identify effective policy approaches to improve diet at the population level. Identifying and intervening upon the mechanisms that shape population-level diet will likely require considering how multiple multilevel influences interact to comprise a complex and dynamic system.[1] These multilevel influences include factors at the community (e.g., social norms), environment (e.g., food access), household (e.g., income), and individual (e.g., preferences) levels. Complex systems can include feedback loops (e.g., access to

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Combined maintenance and routing optimization for large-scale sewage cleaning

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Oscar O. Guaje;
Daniel Duque;
Raha Akhavan-Tabatabaei;
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Combined maintenance and routing optimization for large-scale sewage cleaning

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Abstract

The rapid population growth and the high rate of migration to urban areas impose a heavy load on the urban infrastructure. Particularly, sewerage systems are the target of disruptions, causing potential public health hazards. Although sewer systems are designed to handle some sediment and solid transport, particles can form deposits that increase the flood risk. To mitigate this risk, sewer systems require adequate maintenance scheduling, as well as ad-hoc repairs due to unforeseen disruptions. To address this challenge, we tackle the problem of planning and scheduling maintenance operations based on a deterioration pattern for a set of geographically spread sites, subject to unforeseen failures and restricted crews. We solve the problem as a two-stage maintenance-routing procedure. First, a maintenance model driven by the probability distribution of the time between failures determines the optimal time to perform maintenance operations for each site. Then, we design and apply an LP-based split procedure to route a set of crews to perform the planned maintenance operations at a near-minimum expected cost per unit time. Afterward, we adjust this routing solution dynamically to accommodate unplanned repair operations arising as a result of unforeseen failures. We validated our proposed method on a large-scale case study for sediment-related sewer blockages in Bogotá (Colombia). Our methodology reduces the cost per unit time in roughly 18% with respect to the policy used by the city's water utility company.

Keywords Maintenance models · Sediment-related sewer blockages · Sewer system maintenance planning · Split procedure · Vehicle routing

1 Introduction

Rapid population growth and the high rate of people migrating to urban areas have generated a faster and unplanned urbanization process (United Nations 2016; Vammen 2015; Angel et al. 2016). This, along with the change in land use, have an important impact on the urban catchment hydrology, resulting in both higher runoff and solid transportation rates (Fletcher et al. 2013). More populated and denser cities are commanded to provide more efficient,

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Optimization model for urban air quality policy design: A case study in Latin America

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Optimization model for urban air quality policy design: A case study in Latin America

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ABSTRACT

Air pollution is a major problem caused by urban growth and poses a high risk to human health. To mitigate the negative impact of pollution, some cities have implemented air quality strategies that regulate emissions from multiple sources. However, when such strategies are applied in isolation they may fail to comply with stringent environmental goals. To support the development of comprehensive urban air quality policy, we propose an optimization model that suggests a portfolio of mitigation actions that captures realistic aspects of air quality policy-making such as implementation cost, pollution goals, interdependencies between alternatives, and managerial and regulatory constraints. We illustrate the advantages of our model with a real case study in Bogotá, Colombia's capital and one of the largest cities of Latin America, where new legislation established a PM_{10} air quality standard. To achieve the environmental goal, our model suggests an optimal portfolio consisting of six mitigation actions targeting mobile and stationary sources. Interventions in the transport sector alone generate 70% of the emissions reduction. The PM_{10} goal is achieved with a net incremental cost of US$1 billion with respect to the no-intervention scenario. The optimization model and results presented in this article were formally adopted as the official air quality policy in the city.

1. Introduction

The sustainable growth of cities is one of the major challenges of modern times. In 2014, more than 54% of the world's population lived in urban areas, with 28 M-cities having more than 10 million inhabitants (United Nations, Department of Economic and Social Affairs, Population Division, 2014). In addition, small- and medium-sized cities (less than one million inhabitants) are increasing in number and many are growing rapidly (United Nations, Department of Economic and Social Affairs, Population Division, 2014). By 2050, the fraction of the world's population living in urban areas is expected to increase to 66% and more than 13 new mega-cities are likely to emerge (United Nations, Department of Economic and Social Affairs, Population Division, 2015). As a result, cities will face numerous challenges in terms of housing, transportation, health infrastructure, and provision of general services, most of which are already current pressing problems (Stevenson & Gleeson, 2019).

Air pollution is one of the major problems caused by urban growth (Johnson, 2001). The increasing demand of services in urban areas results in air quality deterioration due to multiple factors. Unplanned urban sprawl is associated with an increasing reliance on private cars (Frumkin, 2002), higher miles traveled (Brown, 2013), and longer commute times (Mraihi, Harizi, Mraihi, & Bouzidi, 2015; Travisi, Camagni, & Nijkamp, 2010), all worsening urban air quality. To accommodate the rising urban population, cities expand into the surrounding areas often locating new developments around industrial districts. As a result, inhabitants may be exposed to harmful pollution sources (Arif, Kumar, Kumar, Eric, & Gourav, 2018). In some cities, the increase in residential activities that intensively use biomass or fossil fuels, such as cooking, heating, and lighting, may contribute significantly to the deterioration of urban air quality (World Health Organization (WHO), 2019a; World Health Organization (WHO), 2019b).

Air pollution is the environmental problem that poses the highest risk to human health, killing almost 3 million people each year due to its related chronic diseases (World Health Organization (WHO), 2016). The link between exposure to urban air pollutants and health problems is well documented, including higher risks of lung cancer (Nyberg et al.,

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Predicting the Johnson Cook constitutive model constants using temperature rise distribution in plane strain machining

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ORIGINAL ARTICLE

Predicting the Johnson Cook constitutive model constants using temperature rise distribution in plane strain machining

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Abstract

Johnson-Cook (JC) constitutive material model is the most common, yet simplest, model to describe the material behavior in machining that involves high strain and high strain rates accompanied with high temperature rise. Many studies have tried to predict JC model constants using computational and analytical procedures. However, these approaches are limited by computational costs and experimental restrictions. In this study, an original approach to determine the JC material model constants is proposed using the effects imposed by strain hardening, strain rate hardening, and thermal softening. An analytical approach is established upon the chip formation model in orthogonal cutting—plane strain machining—where the JC model is applied to calculate cutting energy due to plasticity and friction which ultimately involves temperature rise. Temperature is calculated at primary shear zone and secondary deformation zone using Oxley and modified Hahn's models, which are dependent on material behavior and five JC constants. JC constants are calculated by performing a multi-objective optimization algorithm that searches for the minimum differences between the calculated temperature in the chip and the experimental results of temperature for different cutting conditions. The obtained JC constants are compared with the literature and close agreements are achieved. The appeal of the proposed methodology is in its low computational time, low experimental complexity, and low mathematical complexity. Finally, JC constants were used in finite element simulation of PSM to verify the model's robustness and accuracy via comparing the cutting force, temperature distribution, and subgrain size of the chip for different cutting conditions.

Keywords Orthogonal machining process · Johnson-Cook material constants · Chip formation model · Temperature measurements

1 Introduction

Modeling and simulation of machining-based manufacturing processes are essential to decrease the costs associated with the experimental investigations of cutting force and microstructural prediction of different cutting conditions. Machining involves removing material using a wedge-shaped cutting tool through imposing high levels of strain and stain rate coupled with temperature rise in the deformation zone of the machined material. Constitutive material models play a vital role in representing the behavior of the material subject to different mechanical and thermal loading settings or, in other words, different cutting conditions during orthogonal cutting process. Subsequently, constitutive material models are central pillars in predicting machining force, residual stress, temperature, among others, and are indispensable elements of the analytical modeling, investigation, as well as optimization of the machining process.

The Johnson-Cook (JC) model is one of the most widely used constitutive models in analytical modeling and in finite element simulation of machining, since it is effectual, uncomplicated, and relatively practical. Many researchers have been using the JC model extensively with the aim of estimating machining force, temperature, and residual stress [1, 2]. Previous works have successfully implemented JC model in numerical analyses of the deformation processes [3–5]. JC model accounts for plastic deformation behavior and flow stress response by taking into account strain and strain rate hardening as well as temperature softening,

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Model for optimal sectioning of hydrocarbon transportation pipelines by minimization of the expected economic losses

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Model for optimal sectioning of hydrocarbon transportation pipelines by minimization of the expected economic losses

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ABSTRACT

Pipelines are the safest and most cost-effective alternative for transporting oil and refined products. Nevertheless, accidental losses of containment (LOCs) may occur, thus posing significant threats to people and the surrounding environment. These LOCs also lead to substantial economic losses due to remediation, commodity loss, emergency response, and property damage. The effects of an LOC might be mitigated by implementing proper maintenance plans and installing sectioning valves (i.e., blocking). The location and number of sectioning valves depend on the type of pipeline (underground or non-underground), the commodity being transported, the neighboring population density, and altimetry. Therefore, defining the optimal location and number of valves in a pipeline is a challenging decision that goes beyond the static distances suggested by recognized standards such as CSA Z662. In this paper, a model is proposed to determine the optimal number and location of sectioning valves, which minimize the expected economic losses in terms of the amount of volume spilled and the costs of remediation, emergency response efforts, repair, and commodity loss. The model is applied to a real oil pipeline with significant changes in altimetry. The results indicate a reduction between 10 and 18% of the expected economic losses compared with a static distance reported by CSA Z662.

1. Introduction

Pipelines are usually the preferred method to transport hazardous materials such as crude oil, refined oil products, highly volatile liquids, and biofuels mainly because they are considered the safest and most cost-effective alternative compared to train or ground transportation (Grigoriev and Grigorieva, 2009). Nevertheless, this mean of transportation is subject to different threats that may produce a loss of containment (LOC) that leads to human and environmental damage, and can trigger substantial economic losses regarding remediation, commodity loss, emergency response efforts, and property damage. This situation is a matter of concern because nearly 40% of the pipeline networks worldwide have reached their projected 20-year service lifetime (Azevedo, 2007). Although pipeline accident databases such as the Pipeline Hazardous Material Safety Administration (PHMSA), European Gas Pipeline Incident Data Group (EGIG), and CONCAWE reported lately that the number of LOCs have decreased with time (falling into failures rates from 1e-04 to 1e-03 incidents/km·year; see Aloqaily (2018)), there are still an important number of accidents with significant economic losses every year. For instance, according to PHMSA during 2009–2018, there was an average of 540 annual incidents of LOCs for onshore pipelines transporting hazardous liquids and gas. These accidents led to an average cost of 480 million dollars per year, which included property damage, commodity loss, emergency response efforts, and environmental remediation (Pipeline and Hazardous Materials Safety Administration, 2018).

Although the consequences of LOCs are not limited to economic ones. They also include possible impacts on environmental sustainability and the surrounding people (i.e., injuries or even deaths). The costs produced by a LOC are commonly used for risk-based decision-making processes Medina et al. (2012). Risk assessment is recognized as a valuable tool to support decisions seeking for a safe operation based on inspections and preventive/corrective maintenance (Cunha, 2016). Overall, a risk assessment is performed by estimating the probability of occurrence and the severity of the consequences that this event may produce (Shin et al., 2018). This assessment is then implemented in a risk management framework, willing to support decisions that reduce non-adequate risks. In this direction, decisions can focus on reducing the probability of failure or mitigating the severity of a given scenario. On the one hand, preventive decisions depend on the pipeline's current

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Commute patterns and depression: Evidence from eleven Latin American cities

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Commute patterns and depression: Evidence from eleven Latin American cities

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ABSTRACT

Introduction: Although travel behavior is expected to influence personal health, few studies have examined associations with mental health. This study examines associations between commute patterns and mental health using survey data in 11 Latin American cities.

Methods: Using a survey conducted by the Development Bank of Latin America in 2016, we measured the presence of depressive symptoms using the 10-item Center for Epidemiologic Studies Depression (CESD-10) screening scale. We used multilevel non-linear models to estimate the magnitude of the associations between commute patterns and depression risk, adjusting for socio-demographic and neighborhood characteristics.

Results: We found that, on average, every 10 more minutes of commuting time is associated with 0.5% ($p = 0.011$) higher probability of screening positively for depression. Furthermore, when decomposing commuting time into free-flow time and delay time, we found that delay and not free-flow time, were associated with depression. Specifically, every 10 additional minutes of traffic delay is associated with 0.8% ($p = 0.037$) higher probability of screening positively for depression. When examining differences by travel mode, we find that users of formal transit (e.g. subway or bus rapid transit) are 4.8% ($p = 0.040$) less likely to be screened positively for depression than drivers. In addition, not having transit stops within a 10-min walk from home is associated with higher probability of screening positively for depression.

Conclusions: Our findings provide preliminary evidence that better access to mass transit systems and less congestion may be linked to better mental health among urban residents.

RESUMEN

Introducción: Aunque se espera que el comportamiento de viajeros afecte su salud personal, pocas investigaciones han estudiado el efecto de estos comportamientos sobre la salud mental. En este estudio examinamos asociaciones entre patrones de viaje y salud mental en individuos de 11 ciudades de América Latina.

Métodos: Utilizamos una encuesta del Banco de Desarrollo de América Latina (CAF) del 2016, para medir la presencia de síntomas depresivos con la escala de tamizaje de depresión del Center for Epidemiologic Studies (CESD-10). Usamos modelos de multinivel no-lineales para estimar asociaciones entre patrones de viaje y riesgo de depresión, ajustando por factores socio-demográficos individuales y características del vecindario de residencia.

Resultados: Encontramos que en promedio, cada 10 minutos adicionales de tiempo de viaje están

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An exact method for a class of robust shortest path problems with scenarios

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An exact method for a class of robust shortest path problems with scenarios

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Abstract

In this variant of the robust shortest path problem, the cost of traversing an arc is given by a discrete set of scenarios. The problem is then to find a (robust) path that takes into account the information arising from the multiple cost realizations of the possible scenarios. To account for a robust path, we adopt the *bw*-robustness criterion, which ameliorates the dramatic role played by worst-case approaches. Under this criterion, the parameter b represents a desirable upper bound for the cost that the decision maker wants for most of the scenarios; while parameter w strictly bounds the cost and represents a value that the decision maker is not willing to exceed in any scenario. To solve the problem, we extend the pulse algorithm, a general-purpose solution strategy that has been used on shortest path problems with side constraints. The proposed algorithm compares favorably against an integer programming approach both in terms of speed and scalability on networks with up to 39 377 nodes and 192 094 arcs.

KEYWORDS

bw-robustness, data-driven robust optimization, robustness, routing, shortest path, pulse algorithm

1 | INTRODUCTION

The robust shortest path (RSP) problem is a generalization of the well-known shortest path problem that takes into account the uncertainty on the parameters. Particularly, the cost of traversing an arc is no longer a fixed value, because it might not be determined accurately in practical applications. Given this source of uncertainty, it is convenient to look for a robust solution that accounts for the inherent variation of the cost of a path. There is no agreement among the concept of a robust path because there are several ways to model the parameters' uncertainty and to address their variability. Roy [22] presents different definitions of robustness and discusses how these variants can be used in the wide area of operations research. Kasperski and Zieliński [11] review recent results on robust discrete optimization.

Despite of the modeling approach or the robustness criterion, the RSP is known to be NP-hard [1, 8, 19, 25]. Murthy and Her [18] proposed one of the first approaches to solve the RSP. To model uncertainty, they adopt a scenario approach in which the cost of traversing an arc is given by a discrete set of scenarios. Using this characterization, they used dynamic programming (DP) to solve the min-max shortest path problem—also known as the absolute robust shortest path (ARSP) problem—with a label correcting algorithm that looks for a path that minimizes the maximum path cost among the scenarios. Yu and Yang [25] studied the ARSP and the robust deviation shortest path problem (RDSP). In their work on the RDSP, they look for a path that minimizes the maximum deviation between the cost of the path in a particular scenario and the cost of the shortest path of the corresponding scenario. Montemanni and Gambardella [15] studied the RDSP, but they characterize the uncertainty over the costs with interval data. Under this approach, the cost of each arc belongs to a non-negative interval of continuous values. To solve the problem they proposed a ranking algorithm [15] followed by a sequel work where they used Benders' decomposition [16]. The work by Montemanni and Gambardella [15, 16] is based on the min-max and min-max regret view of robustness for

Data driven methodology for model selection in flow pattern prediction

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Data driven methodology for model selection in flow pattern prediction

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ABSTRACT

The determination of multiphase flow parameters such as flow pattern, pressure drop and liquid holdup, is a very challenging and valuable problem in chemical, oil and gas industries, especially during transportation. There are two main approaches to solve this problem in literature: data based algorithms and mechanistic models. Although data based methods may achieve better prediction accuracy, they fail to explain the two-phase characteristics (i.e. pressure gradient, holdup, gas and liquid local velocities, etc.). Recently, many approaches have been made for establishing a unified mechanistic model for steady-state two-phase flow to predict accurately the mentioned properties. This paper proposes a novel data-driven methodology for selecting closure relationships from the models included in the unified model. A decision tree based model is built based on a data driven methodology developed from a 27670 points data set and later tested for flow pattern prediction in a set made of 9224 observations. The closure relationship selection model achieved high accuracy in classifying flow regimes for a wide range of two-phase flow conditions. Intermittent flow registering the highest accuracy (86.32%) and annular flow the lowest (49.11%). The results show that less than 10% of global accuracy is lost compared to direct data based algorithms, which is explained by the worse performance presented for atypical values and zones close to boundaries between flow patterns.

1. Introduction

Multiphase flows in pipes are complex physical processes which are very common in chemical industry (Picchi and Poesio, 2017). For example, during petroleum transportation, fluids are pushed upwards from oil wells using gas injection, water and steam to improve the production rate of the system. Once the product is extracted, it is taken to processing facilities through a pipeline system, where the complexity of the process depends on the ground conditions of the area that in hilly-terrain carries to a wide range of pipe inclination angles. Accordingly, for design and planning of fluid transportation systems it is very important to correctly estimate and predict multiphase flow parameters such as flow regime, pressure gradient, hold-up, gas and liquid velocities and shear stress.

One of the main properties in the study of two-phase flows is the flow regime, which makes reference to the spatial distribution of the gas and liquid phases during the flow in pipes. The correct estimation of the regimes is fundamental in two-phase analysis, taking into account that design variables such as pressure drop, phase holdup, rate of chemical reaction and others, are strongly related to the registered flow pattern (Pereyra et al., 2012). There are two main approaches to predict the flow regime in a particular configuration. Firstly, there are direct methods based on data analysis that, considering different sets of variables, can estimate the flow type. Taking into account that flow patterns depend on parameters such as pipe inclination, diameter and length, physical properties of the phases, and superficial velocities (Shippen and Bailey, 2012), many machine learning approaches have been developed in the last years to identify flow patterns (e.g. Xie et al. (2004); Al-Naser et al. (2016); Amaya-Gómez et al. (2019)). These methodologies can achieve high predictive performance (e.g. accuracy), however, they are difficult to interpret do not predict simultaneously more two-phase flow characteristics apart of the specific regime.

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Microstructure prediction in low and high strain deformation of Al6063 using artificial neural network and finite element simulation

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ORIGINAL ARTICLE

Microstructure prediction in low and high strain deformation of Al6063 using artificial neural network and finite element simulation

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Abstract

The final microstructure of materials under interactive effects of critical elements of deformation: strain, strain-rate, and temperature, often follows complex trajectories. Capturing the existing process-structure linkages is fundamental for controlling product outcomes, yet it calls for establishing the constitutive relationships that describe material behavior. In this paper, a backpropagation Artificial Neural Network (ANN) is proposed for microstructure prediction for a wide range of strain, strain-rate, and temperature conditions. Microstructural changes in Al6063 are experimentally examined using (i) quasi-static universal testing apparatus, Drop Weight Impact Tester (DWIT), and Split Hopkinson Pressure Bar (SHPB) tests for low strain regimes at elevated temperatures, and (ii) Plane Strain Machining (PSM) for high strain, high strain-rate, and the accompanied temperature rise conditions. Two ANNs are established to predict microstructure responses, grain and subgrain sizes, in low and high strain regimes, respectively. Additionally, the stress-strain results obtained from the low strain regime are used to calculate the Johnson–Cook (J-C) material model constants, which are then incorporated in the finite element (FE) simulation along with the developed ANN algorithm, to predict microstructure response for different cutting conditions. The performance of the ANNs and the FE simulations was evaluated using statistical indices. The comparative assessment of the models' outcomes indicates close agreements with the experimental results in both low- and high-level deformations. The accurate predictions from PSM conditions can potentially be applicable for microstructural prediction of the machined surface.

Keywords Microstructure · Deformation · Finite element · Neural network · Back propagation

1 Introduction

Thermomechanical forming processes are often accompanied by enhanced mechanical and physical properties that are directly relevant to the final microstructure. In these processes, it is of great interest to establish a framework with the objective of controlling the resulting microstructure. However, to accomplish this, it is essential to determine the behavior of the material in response to the complicated effects stemming from the wide range of thermomechanical conditions, i.e., strains, strain-rates, and the coupled temperature rise. Control frameworks for the microstructure responses can potentially decrease the design costs and enhance product life cycles, but demands reliable constitutive models and calls for understanding the intricate interrelationships among the critical deformation conditions. The availability of such models is quite limited, especially when the aim is to include the coupled effects of thermomechanical conditions on the flow stress up to large deformation levels. Extensive research has been conducted with the aim of developing constitutive models for different ranges of thermomechanical conditions [1–3]. In addition to this, numerical models, such as finite element simulation, have been developed to facilitate the modeling of the forming processes aiming for a minimum cost of experimentation analysis [4, 5]. Nevertheless, the simulations would still call for a constitutive model to account for the behavior of

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