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Application of adaptive neuro-fuzzy system in prediction of nanoscale and grain size effects on formability

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Abstract. Grain size in sheet metals in one of the main parameters in determining formability. Grain size control in industry requires delicate process control and equipment. In the present study, effects of grain size on the formability of steel sheets is investigated. Experimental investigation of effect of grain size is a cumbersome method which due to existence of many other effective parameters are not conclusive in some cases. On the other hand, since the average grain size of a crystalline material is a statistical parameter, using traditional methods are not sufficient for find the optimum grain size to maximize formability. Therefore, design of experiment (DoE) and artificial intelligence (AI) methods are coupled together in this study to find the optimum conditions for formability in terms of grain size and to predict forming limits of sheet metals under bi-stretch loading conditions. In this regard, a set of experiment is conducted to provide initial data for training and testing DoE and AI. Afterwards, the using response surface method (RSM) optimum grain size is calculated. Moreover, trained neural network is used to predict formability in the calculated optimum condition and the results compared to the experimental results. The findings of the present study show that DoE and AI could be a great aid in the design, determination and prediction of optimum grain size for maximizing sheet formability.
Keywords: artificial intelligence (AI); design of experiment (DoE); formability; forming limits diagram (FLD); grain size

1. Introduction

Formability of sheet metals have been a subject of interest for a long time. However, a complete understanding of formability assessment is still under investigation (Luo *et al*. 2022a, Luo *et al*. 2022b, Zhao *et al*. 2022a). This issue is partly originated from presence of numerous parameters affecting formability and partly come from emerge of new alloys and metallic materials (Xu *et al*. 2022, Wang *et al*. 2022b, Wu *et al*. 2022). There exist several experimental and theoretical methods to evaluate forming limit diagrams (FLDs) of sheet metals. On the other hand, presentation of formability is also a main concern in the industry. Although sheet production and sheet customers are using strain based FLDs, studies showed that stress based FLDs have some undeniable merits in comparison to strain based diagrams (Zhang *et al*. 2020, Zhu and Zhao 2022, Zuo and Lin 2022). All of these categories of concerns make formability prediction a current issue in the material and mechanical science (Liu *et al*. 2021c, Gong *et al*. 2022, Jiang *et al*. 2022).

Factors affecting the strain based FLD are categorized in three kinds (Adamian *et al*. 2020, Al-Furjan *et al*. 2020a, b, Li *et al*. 2020b, Liu *et al*. 2020b, 2021b, Zare *et al*. 2020, Dai *et al*. 2021c, Habibi *et al*. 2021, He *et al*. 2021, Huang *et al*. 2021, Zhang *et al*. 2021). First category includes microstructural based factors similar to grain orientation (Noell *et al*. 2017, Park and Shin 2017, Abdolvand *et al*. 2018, Amelirad and Assempour 2019, 2021, Shang *et al*. 2019, Zhu *et al*. 2019, Azghandi *et al*. 2020, Feather *et al*. 2020, Habibi *et al*. 2021), grain size distribution (Amelirad and Assempour 2019), and existence of second phase in the alloy (Lande and Mitzner 2006, Querin *et al*. 2007, Zhang and Wang 2012, Fazaeli *et al*. 2016, Mirsalehi *et al*. 2017). Second parameters are related to stress-strain behavior of the sheet metal like elastic and plastic behavior (Zadpoor *et al*. 2008, 2009, Dilmec *et al*. 2013, Habibi *et al*. 2021), necking shape and rate-dependency of metal. Third category related to the forming condition including temperature and friction coefficient (Casari *et al*. 2006, Naik *et al*. 2010, Zhang *et al*. 2017). All these parameters were investigated individually or combined with few other parameters in literature. However, a comprehensive survey could not be found and in some it is barely possible to consider all of the known and unknown parameters. Therefore, different in silico approaches in determining FLDs have not been satisfactorily successful until now. Shang *et al*. (2019) studied the effects of grain size on the void nucleation in metallic samples. They used both experimental and crystal plasticity method to observe the distribution and coalescence of the voids in sample with different grain sizes. It was shown that the behavior of void

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nucleation, growth and coalescence was significantly altered by grain size. Park and Shin (2017) improved the formability of AZ31 alloy via controlling grain size. They showed that increasing grain size in this alloy change the active twining system under tensile loading which in turn resulted in higher n-value in power law and lower r-values in the AZ31 alloys. Amelirad and Assempour (2019) utilized crystal plasticity and experimental methods to show the effect of grain size on the formability of 316L stainless steel sheets. It was shown that increasing grain size results in decreasing formability of this alloy sheets. Moreover, they showed that using crystal plasticity simulation acceptable results were obtained for left hand side of the FLD. In this article, the texture is taken to be random. Janssen *et al*. (2006) investigated the effect of grain size on the flow stress in thin pure aluminum sheets. They found that in the thin Al sheets, the well-known Hall-Petch equation could not be applied. On another study, effect of single grain geometry and orientations on the damage initiation in thin sheet metals were investigated by Amelirad and Assempour (2021). They claimed that neighboring grains' orientations with respect to each other considerably affect the sites of damage initiation. The simulation of metal forming processes includes a wide range of methods (Igali *et al*. 2020, Vakondios and Kyratsis 2020). On the other hand, different numerical methods has been adopted in investigation of different behavior of sheets (Safaei *et al*. 2019, Bouafia *et al*. 2021, Dai *et al*. 2021b)

Applications of artificial intelligence and machine learning in the field of engineering sciences are rapidly growing (Casañola-Martin and Pham-The 2019, Akroum *et al*. 2020, Boughaba and Bouabaz 2020, Igali *et al*. 2020, Singh *et al*. 2020a, b, Thinakaran *et al*. 2020, Vakondios and Kyratsis 2020, Arora *et al*. 2021, Mazloom and Mirzamohammadi 2021, Babaei *et al*. 2022, Hou *et al*. 2022, Kesornsit and Sirisathitkul 2022, Moradi *et al*. 2022, Zhou *et al*. 2022). These methods has been applied in different subjects from chemical substances synthesis to prediction of vibration in nano-systems. The flexibility of artificial neural networks (ANN) in training and capability to provide accurate predictions make them widespread in modeling and prediction of different problems. Moradi *et al*. (2022) utilized machine learning method to observe the effects parameters on synthesis of nano-silica particles. They used experimental data on the effects of several parameters on the size of produces nanoparticles. Moreover, DoE method was utilized to obtain optimum condition in synthesis a specific size range of particles. It was concluded that machine learning model could provide satisfying accurate results in prediction of nano-silica particles based on the given input parameters. Neural network was also utilized in prediction of forming limits of sheet metals. Elangovan *et al*. (2010) employed ANN to predict FLD of pure aluminum sheet considering effects of geometrical parameters. They used experimental data to train the ANN and further utilized this ANN to predict effects of different geometrical parameters on the FLD. Derogar and Djavanroodi (2011) considered effects of oil pressure, limit draw ratio and punch stroke on the forming limit strains using neural network method. Kotkunde *et al*. (2014) also considered effects of different parameters including punch speed, blank holder pressure and temperature on the titanium alloy sheets employing ANN. They demonstrated that predictions made by ANN were in desirable agreement with experimental results.

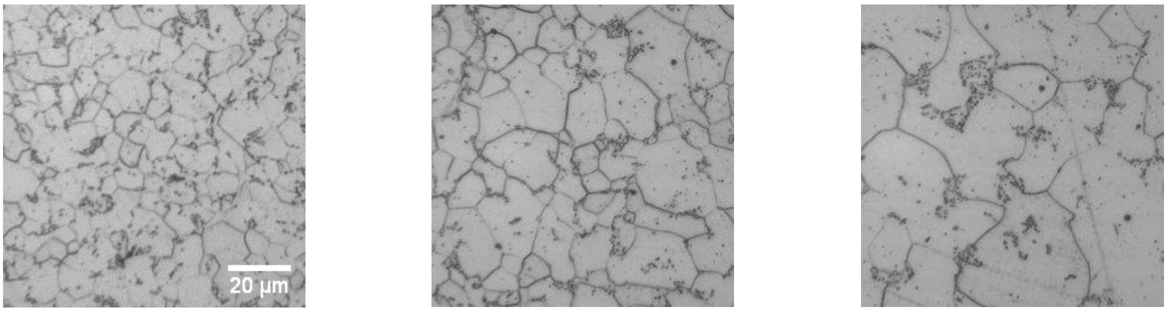
Owing to extraordinary costs in some parametric experimental studies, design of experiments (Fisher 1936) is vitally important to get to the point of the required results. Consequently, prior to do the experimental works, it is necessary to list the dependent and independent variables and their limits in the scope of the study. Afterwards, a set of minimum required experiments to get insight of the behavior and effects of different variable should be conducted. Even extra experiments should have performed wisely to extract maximum outcome from them. The behavior of the outcome of the study, for example FLD, is determined using polynomial fitting. In most cases quadratic polynomials are sufficient to have a conclusive results. Advantages of modeling a process behavior using polynomial is the ease of optimization in such processes. Using methods similar to response surface method (RSM) the optimum conditions could be obtained for a specific output value. Iadicola and Banerjee (2019) proposed a DoE method for investigation of forming limit strains in digital image correlation (DIC) measurements. Kumar *et al*. (2020) used DoE to plan experimental setup for the aim of increasing formability of Inconel 718 in incremental forming procedure.

In the present study, effects of grain size on the formability of steel sheets is investigated. Experimental investigation of effect of grain size is a cumbersome method which due to existence of many other effective parameters are not conclusive in some cases. On the other hand, since the average grain size of a crystalline material is a statistical parameter, using traditional methods are not sufficient for find the optimum grain size to maximize formability. Therefore, design of experiment (DoE) and artificial intelligence (AI) methods are coupled together in this study to find the optimum conditions for formability in terms of grain size and to predict forming limits of sheet metals under bi-stretch loading conditions. In this regard, a set of experiment is conducted to provide initial data for training and testing DoE and AI. Afterwards, the using response surface method (RSM) optimum grain size is calculated. Moreover, trained neural network is used to predict formability in the calculated optimum condition and the results compared to the experimental results.

2. Experimental setup

2.1 Grain size measurement

The sheet metal in the current study is AISI 1008 sheets with 1mm, 1.25mm and 1.5mm thickness (Ban *et al*. 2022, Li *et al*. 2022, Lu *et al*. 2022). The different average grain sizes (AGSs) are considered in this manuscript from 12μm to 60μm as shown in Fig. 1. These grain sizes are obtained by cold rolling a raw sheet to different thicknesses followed by spheroidizing heat treatment. When the cold rolling amount is higher the recrystallization results in finer AGS (Wang *et al*. 2017, Yang *et al*. 2020, Liang *et al*. 2021,



(a) (b) (c)

Fig. 1 Different microstructure of AISI 1008 (a) AGS = 12µm, (b) AGS = 25µm and (c) AGS = 60µm. Magnification 200x, Nital 2%

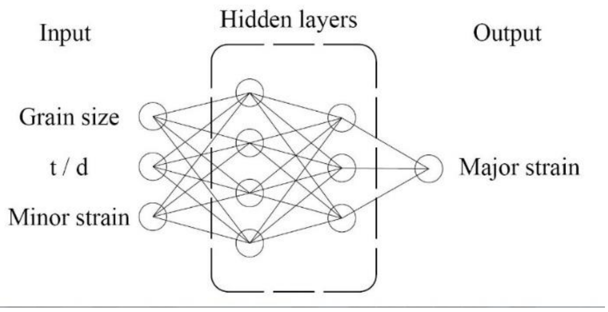
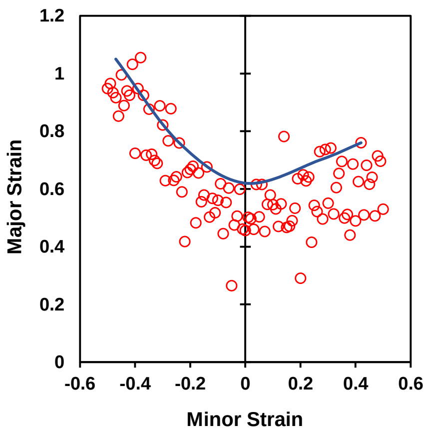
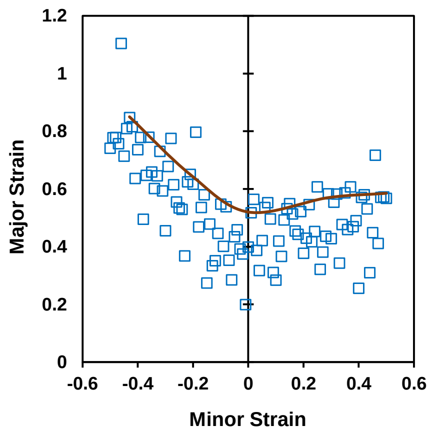


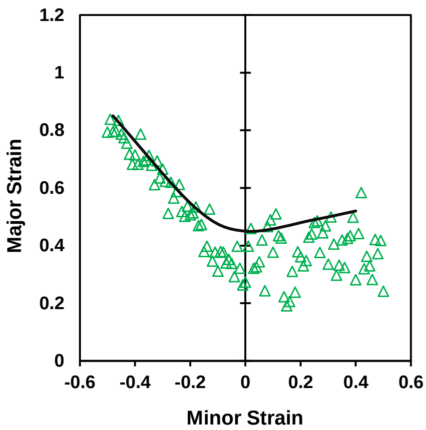
Fig. 2 Designed neural network for determining forming major strain limit.



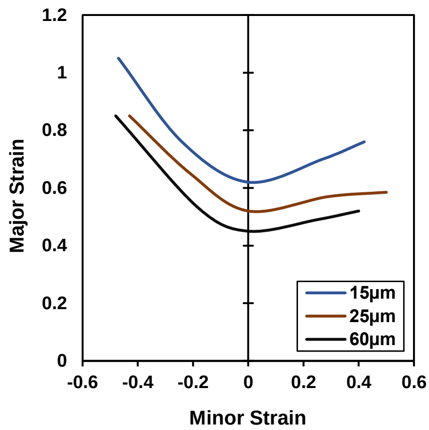
(a) AGS = 12µm



(b) AGS = 25µm



(c) AGS = 60µm



(d) Comparisons of FLCs

Fig. 3 Differences between values calculated by RSM and experimental results for AuNPs size

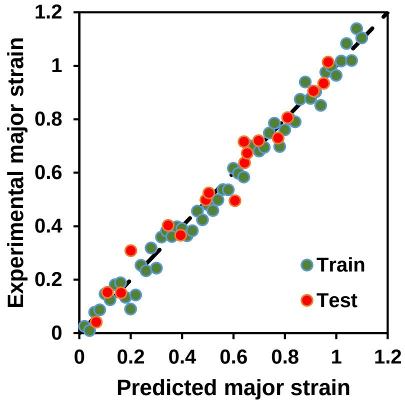


Fig. 4 Predicted and experimental major strain by ANN and hemisphere punch test, respectively

Zhao *et al*. 2022b). The metallography procedure were conducted according to ASTM E7.

2.2 Forming limit curves

Forming limit determination is conducted using hemisphere punch test. The details of such tests could be acquired in different references (Habibi *et al*. 2016, 2018a, b, 2019b, d, e, Ebrahimi *et al*. 2019a, Esmailpoor Hajilak *et al*. 2019, Pourjabari *et al*. 2019, Safarpour *et al*. 2019a, Zhu *et al*. 2022). The punch radius is 25mm and the boundary of punch and sheet was lubricated to reduce the effect of friction. On the other hand, the speed of the punch was kept at 3mm/sec. After the appearance of first signs of necking, the experiments was stopped. Principal in-plane strains were measured by Myler strip using the regular pre-etched net on the outer surface of the sheet metal.

2.3 Design of Experiments (DoE)

The effective parameters in this study is considered to be grain size and sheet thickness. Moreover to simplify the neural network minor strain is also regarded as an input parameter (Habibi *et al*. 2017, 2019a, c, b, Alipour *et al*. 2020, Ebrahimi *et al*. 2020a, Ghazanfari *et al*. 2020, Safarpour *et al*. 2018, 2020, Chen *et al*. 2022). Based on this, having the minimum and maximum values of each parameters, at least 12 set of FLD test should be performed to obtain the sufficient data for analysis (Liu *et al*. 2020a, Wang *et al*. 2020, Zhou *et al*. 2020, Dai *et al*. 2021a, Guo *et al*. 2021a, Shao *et al*. 2021, Wu and Habibi 2021, Kong *et al*. 2022).

2.4 Artificial neural network (ANN)

The schematic representation of ANN designed for the present study is demonstrated in Fig. 2. As seen in this Fig., the ANN includes three different layers including input, hidden and output layers (Hashemi *et al*. 2019, Al- Furjan *et al*. 2020c, d, e, f, Bai *et al*. 2020, Cheshmeh *et al*. 2020, Li *et al*. 2020a, Lori *et al*. 2020, Najaafi *et al*. 2020, Shariati *et al*. 2020c, Xiong *et al*. 2020, Guo *et al*. 2021b, Liu *et al*. 2021a). The data of the input and output layer for train and test the network are provided by experimental results (Shariati *et al*. 2012, 2016a, b, 2019, 2020d, e, f, g, h, i, j, 2021a, b, Fan *et al*. 2022, Luo *et al*. 2022c, Wang *et al*. 2022a, Xia *et al*. 2022). This type of network utilized back propagation algorithm to train the network. Training the network with 80 epochs (iterations) results in <0.1% error of the predicted major strain (Ebrahimi *et al*. 2019b, c, Hashemi *et al*. 2019, Moayedi *et al*. 2019, 2020a, b, Mohammadgholiha *et al*. 2019, Mohammadi *et al*. 2019, Ebrahimi *et al*. 2020b, Habibi *et al*. 2020, Oyarhossein *et al*. 2020, Shariati *et al*. 2020a, b, Shokrgozar *et al*. 2020).

3. Results

The experimental results of the forming limit test is presented in Fig. 3 for 1mm thickness sheet. The curves are constructed on the upper bound of the safe point which are depicted alongside with the FLCs in Fig. 3a, b, and c. In Fig. 3d, the FLCs are compared with each other. As seen, increasing the grain size from 15 to 60µm cause a significant reduction in formability of AISI 1008 sheets. The values of FLD_0 for 15µm, 25µm and 60µm grain sizes are 0.62, 0.52 and 0.45 respectively. Therefore, it can be deduced that smaller average grain sized are in favor of formability. However, production of small grain size requires additional cold work on the sheet metal to produce smaller grain sizes during recrystallization. On some cases, this high values of forming limit strains are not needed and larger grain sizes near 25µm might be adequate for some applications. Thus, dependent on the application different grain sizes could be employed.

The results of the ANN prediction are presented in Fig. 4. The correlations between train data is R^2 = 0.9923 and for test data is R^2 = 0.9854 which is highly acceptable in such problems. This high values of the correlations factors indicate that (1) the forming limit major strain is well-behaved function of grain size and thickness of the sheet and (2) the designed ANN is a reliable model which can be further employed in similar alloys and conditions for different grain sizes and thicknesses close to 1mm to 1.5mm.

4. Conclusions

In the present study, effects of grain size on the formability of steel sheets was investigated. Experimental investigation of effect of grain size was a cumbersome method which due to existence of many other effective parameters were not conclusive in some cases. On the other hand, since the average grain size of a crystalline material is a statistical parameter, using traditional methods are not sufficient for find the optimum grain size to maximize formability. Therefore, design of experiment (DoE) and artificial intelligence (AI) methods were coupled together in this study to find the optimum conditions for formability in terms of grain size and to predict forming limits of sheet metals under bi-stretch loading conditions. In this regard, a set of experiment was conducted to provide initial data for training and testing DoE and AI. Afterwards, the using response surface method (RSM) optimum grain size was calculated. Moreover, trained neural network was used to predict formability in the calculated optimum condition and the results compared to the experimental results.

• Increasing the grain size from 15 to 60μm cause a significant reduction in formability of AISI 1008 sheets.

• Production of small grain size requires additional cold work on the sheet metal to produce smaller grain sizes during recrystallization.

• The forming limit major strain is well-behaved function of grain size and thickness of the sheet.

• The designed ANN is a reliable model which can be further employed in similar alloys and conditions for different grain sizes and thicknesses close to 1mm to 1.5mm.

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References

Abdolvand, H., Wright, J. and Wilkinson, A.J. (2018), "Strong grain neighbour effects in polycrystals", *Nature Commun.*, **9**(1), 171. https://doi.org/10.1038/s41467-017-02213-9

Adamian, A., Safari, K.H., Sheikholeslami, M., Habibi, M., Al-Furjan, M. and Chen, G. (2020), "Critical temperature and frequency characteristics of GPLs-reinforced composite doubly curved panel", *Appl. Sci.*, **10**(9), 3251. https://doi.org/10.3390/app10093251

Akroum, H., Akroum-Amrouche, D. and Aibeche, A. (2020), "Modeling methods used in bioenergy production processes: A review", *Adv. Comput. Des.*, **5**(3), 323-347. https://doi.org/10.12989/acd.2020.5.3.323

Al-Furjan, M., Dehini, R., Khorami, M., Habibi, M. and won Jung, D. (2020a), "On the dynamics of the ultra-fast rotating cantilever orthotropic piezoelectric nanodisk based on nonlocal strain gradient theory", *Compos. Struct.*, 112990. https://doi.org/10.1016/j.compstruct.2020.112990

Al-Furjan, M., Fereidouni, M., Habibi, M., Abd Ali, R., Ni, J. and Safarpour, M. (2020b), "Influence of in-plane loading on the vibrations of the fully symmetric mechanical systems via dynamic simulation and generalized differential quadrature framework", *Eng. Comput.*, 1-23. https://doi.org/10.1007/s00366-020-01177-7

Al-Furjan, M., Fereidouni, M., Sedghiyan, D., Habibi, M. and won Jung, D. (2020c), "Three-dimensional frequency response of the CNT-Carbon-Fiber reinforced laminated circular/annular plates under initially stresses", *Compos. Struct.*, 113146. https://doi.org/10.1016/j.compstruct.2020.113146

Al-Furjan, M., Habibi, M., won Jung, D. and Safarpour, H. (2020d), "Vibrational characteristics of a higher-order laminated composite viscoelastic annular microplate via modified couple stress theory", *Compos. Struct.*, 113152. https://doi.org/10.1016/j.compstruct.2020.113152

Al-Furjan, M., Moghadam, S.A., Dehini, R., Shan, L., Habibi, M. and Safarpour, H. (2020e), "Vibration control of a smart shell reinforced by graphene nanoplatelets under external load: Semi-numerical and finite element modeling", *Thin Wall. Struct.*, 107242. https://doi.org/10.1016/j.tws.2020.107242

Al-Furjan, M., Oyarhossein, M.A., Habibi, M., Safarpour, H. and Jung, D.W. (2020f), "Frequency and critical angular velocity characteristics of rotary laminated cantilever microdisk via two-dimensional analysis", *Thin Wall. Struct.*, **157**, 107111. https://doi.org/10.1016/j.tws.2020.107111

Alipour, M., Torabi, M.A., Sareban, M., Lashini, H., Sadeghi, E., Fazaeli, A., Habibi, M. and Hashemi, R. (2020), "Finite element and experimental method for analyzing the effects of martensite morphologies on the formability of DP steels", *Mech. Based Des. Struct.*, **48**(5), 525-541. https://doi.org/10.1080/15397734.2019.1633343

Amelirad, O. and Assempour, A. (2019), "Experimental and crystal plasticity evaluation of grain size effect on formability of austenitic stainless steel sheets", *J. Manuf. Pr.*, **47**, 310-323. https://doi.org/10.1016/j.jmapro.2019.09.035

Amelirad, O. and Assempour, A. (2021), "Coupled continuum damage mechanics and crystal plasticity model and its application in damage evolution in polycrystalline aggregates", *Eng. Comput.*, 1-15. https://doi.org/10.1007/s00366-021-01346-2

Arora, M., Dhawan, S. and Singh, K. (2021), "Improved performance of machine learning algorithms for prognosis of cervical cancer", *Adv. Comput. Des.*, **6**(3), 191-205. https://doi.org/10.12989/ACD.2021.6.3.191

Azghandi, S.H.M., Weiss, M. and Barnett, M.R. (2020), "The effect of grain size on the bend forming limits in AZ31 Mg Alloy", *JOM*, **72**(7), 2586-2596. https://doi.org/10.1007/s11837-020-04073-z

Babaei, M., Atasoy, A., Hajirasouliha, I., Mollaei, S. and Jalilkhani, M. (2022), "Numerical solution of beam equation using neural networks and evolutionary optimization tools", *Adv. Comput. Des.*, **7**(1), 1-17. https://doi.org/10.12989/ACD.2022.7.1.001

Bai, Y., Alzahrani, B., Baharom, S. and Habibi, M. (2020), "Semi-numerical simulation for vibrational responses of the viscoelastic imperfect annular system with honeycomb core under residual pressure", *Eng. Comput.*, 1-26. https://doi.org/10.1007/s00366-020-01191-9

Ban, Y., Liu, M., Wu, P., Yang, B., Liu, S., Yin, L. and Zheng, W. (2022), "Depth estimation method for monocular camera defocus images in microscopic scenes", *Electronics*, **11**(13). https://doi.org/10.3390/electronics11132012

Bouafia, H., Chikh, A., Bousahla, A.A., Bourada, F., Heireche, H., Tounsi, A., Benrahou, K.H., Tounsi, A., Al-Zahrani, M.M. and Hussain, M. (2021), "Natural frequencies of FGM nanoplates embedded in an elastic medium", *Adv. Nano Res.*, **11**(3), 239-249. https://doi.org/10.12989/anr.2021.11.3.175

Boughaba, A. and Bouabaz, M. (2020), "Identification and risk management related to construction projects", *Adv. Comput. Des.*, **5**(4), 445-465. https://doi.org/10.12989/acd.2020.5.4.445

Casañola-Martin, G.M. and Pham-The, H. (2019), "Machine learning applications in nanomedicine and nanotoxicology: An overview", *Int. J. Appl. Nanotech. Res.*, **4**(1), 1-7. https://doi.org/10.4018/IJANR.2019010101

Casari, F., Tassan, M., Messina, A. and Molinari, A. (2006), "Effect of punch diameter, grid dimension, and lubrication on forming limit diagram", *J. Test. Evaluat.*, **34**(1), 24-30. https://doi.org/10.1520/JTE12669

Chen, F., Chen, J., Duan, R., Habibi, M. and Khadimallah, M.A. (2022), "Investigation on dynamic stability and aeroelastic characteristics of composite curved pipes with any yawed angle", *Compos. Struct.*, 115195. https://doi.org/10.1016/j.compstruct.2022.115195

Cheshmeh, E., Karbon, M., Eyvazian, A., Jung, D.w., Habibi, M. and Safarpour, M. (2020), "Buckling and vibration analysis of FG-CNTRC plate subjected to thermo-mechanical load based on higher order shear deformation theory", *Mech. Based Des.*

Struct., 1-24. https://doi.org/10.1080/15397734.2020.1744005
Dai, Z., Jiang, Z., Zhang, L. and Habibi, M. (2021a), "Frequency characteristics and sensitivity analysis of a size-dependent laminated nanoshell", *Adv. Nano Res*., **10**(2), 175. https://doi.org/10.12989/anr.2021.10.2.175
Dai, Z., Jiang, Z., Zhang, L. and Habibi, M. (2021b), "Frequency characteristics and sensitivity analysis of a size-dependent laminated nanoshell", *Adv. Nano Res*., **10**(2), 175-189. https://doi.org/10.12989/anr.2021.10.2.175
Dai, Z., Zhang, L., Bolandi, S.Y. and Habibi, M. (2021c), "On the vibrations of the non-polynomial viscoelastic composite open-type shell under residual stresses", *Compos. Struct*., 113599. https://doi.org/10.1016/j.compstruct.2021.113599
Derogar, A. and Djavanroodi, F. (2011), "Artificial neural network modeling of forming limit diagram", *Mater. Manuf. Pr*., **26**(11), 1415-1422. https://doi.org/10.1080/10426914.2010.544818
Dilmec, M., Halkaci, H.S., Ozturk, F., Livatyali, H. and Yigit, O. (2013), "Effects of sheet thickness and anisotropy on forming limit curves of AA2024-T4", *Int. J. Adv. Manuf. Technol*., **67**(9-12), 2689-2700. https://doi.org/10.1007/s00170-012-4684-0
Ebrahimi, F., Habibi, M. and Safarpour, H. (2019a), "On modeling of wave propagation in a thermally affected GNP-reinforced imperfect nanocomposite shell", *Eng. Comput*., **35**(4), 1375-1389. https://doi.org/10.1007/s00366-018-0669-4
Ebrahimi, F., Hajilak, Z.E., Habibi, M. and Safarpour, H. (2019b), "Buckling and vibration characteristics of a carbon nanotube-reinforced spinning cantilever cylindrical 3D shell conveying viscous fluid flow and carrying spring-mass systems under various temperature distributions", *Proceedings of the Institution of Mechanical Engineers, Part C: Journal of Mechanical Engineering Science*. **233**(13), 4590-4605. https://doi.org/10.1177/0954406219832323
Ebrahimi, F., Hashemabadi, D., Habibi, M. and Safarpour, H. (2020a), "Thermal buckling and forced vibration characteristics of a porous GNP reinforced nanocomposite cylindrical shell", *Microsyst. Technol*., **26**(2), 461-473. https://doi.org/10.1007/s00542-019-04542-9
Ebrahimi, F., Mohammadi, K., Barouti, M.M. and Habibi, M. (2019c), "Wave propagation analysis of a spinning porous graphene nanoplatelet-reinforced nanoshell", *Wave Random Complex Med*., 1-27. https://doi.org/10.1080/17455030.2019.1694729
Ebrahimi, F., Supeni, E.E.B., Habibi, M. and Safarpour, H. (2020b), "Frequency characteristics of a GPL-reinforced composite microdisk coupled with a piezoelectric layer", *Eur. Phys. J. Plus*, **135**(2), 144. https://doi.org/10.1140/epjp/s13360-020-00217-x
Elangovan, K., Sathiya Narayanan, C. and Narayanasamy, R. (2010), "Modelling of forming limit diagram of perforated commercial pure aluminium sheets using artificial neural network", *Comput. Mater. Sci*., **47**(4), 1072-1078. https://doi.org/10.1016/j.commatsci.2009.12.016
Esmailpoor Hajilak, Z., Pourghader, J., Hashemabadi, D., Sharifi Bagh, F., Habibi, M. and Safarpour, H. (2019), "Multilayer GPLRC composite cylindrical nanoshell using modified strain gradient theory", *Mech. Based Des. Struct*., **47**(5), 521-545. https://doi/10.1080/15397734.2019.1566743
Fan, L., Huang, Y., Ji, D., Moradi, Z., Safa, M. and Amine Khadimallah, M. (2022), "Interaction of angular velocity and temperature rise in the thermo-inertia bifurcation buckling of FG laminated nanocomposite annular plates", *Eng. Struct*., **265**, 114518. https://doi.org/10.1016/j.engstruct.2022.114518
Fazaeli, A., Habibi, M. and Ekrami, A.a. (2016), "Experimental and finite element comparison of mechanical properties and formability of dual phase steel and ferrite - pearlite steel with the same chemical composition", *Metall. Eng*., **19**(2), 84-93. https://doi.org/10.22076/me.2017.41458.1064
Feather, W.G., Lim, H. and Knezevic, M. (2020), "A numerical study into element type and mesh resolution for crystal plasticity finite element modeling of explicit grain structures", *Comput. Mech*., 1-23. https://doi.org/10.1007/s00466-020-01918-x
Fisher, R.A. (1936), "Design of experiments", *British Med. J*., **1**(3923), 554.
Ghazanfari, A., Soleimani, S.S., Keshavarzzadeh, M., Habibi, M., Assempuor, A. and Hashemi, R. (2020), "Prediction of FLD for sheet metal by considering through-thickness shear stresses", *Mech. Based Des. Struct*., **48**(6), 755-772. https://doi.org/10.1080/15397734.2019.1662310
Gong, X., Wang, L., Mou, Y., Wang, H., Wei, X., Zheng, W. and Yin, L. (2022), "Improved Four-channel PBTDPA control strategy using force feedback bilateral teleoperation system", *Int. J. Control Automat. Syst*., **20**(3), 1002-1017. https://doi.org/10.1007/s12555-021-0096-y
Guo, J., Baharvand, A., Tazeddinova, D., Habibi, M., Safarpour, H., Roco-Videla, A. and Selmi, A. (2021a), "An intelligent computer method for vibration responses of the spinning multi-layer symmetric nanosystem using multi-physics modeling", *Eng. Comput*., 1-22. https://doi.org/10.1007/s00366-021-01433-4
Guo, Y., Mi, H. and Habibi, M. (2021b), "Electromechanical energy absorption, resonance frequency, and low-velocity impact analysis of the piezoelectric doubly curved system", *Mech. Syst. Signal Pr*., **157**, 107723. https://doi.org/10.1016/j.ymssp.2021.107723
Habibi, M., Darabi, R., Sa, J.C.d. and Reis, A. (2021), "An innovation in finite element simulation via crystal plasticity assessment of grain morphology effect on sheet metal formability", *Proceedings of the Institution of Mechanical Engineers, Part L: Journal of Materials: Design and Applications*. **235**(8), 1937-1951. https://doi.org/10.1177/14644207211024686
Habibi, M., Ghazanfari, A., Assempour, A., Naghdabadi, R. and Hashemi, R. (2017), "Determination of forming limit diagram using two modified finite element models", *Mech Eng*. **48**(4), 141-144. https://doi.org/10.22060/MEJ.2016.664
Habibi, M., Hashemabadi, D. and Safarpour, H. (2019a), "Vibration analysis of a high-speed rotating GPLRC nanostructure coupled with a piezoelectric actuator", *Eur. Phys. J. Plus*, **134**(6), 307. https://doi.org/10.1140/epjp/i2019-12742-7
Habibi, M., Hashemi, R., Ghazanfari, A., Naghdabadi, R. and Assempour, A. (2018a), "Forming limit diagrams by including the M–K model in finite element simulation considering the effect of bending", *Proceedings of the Institution of Mechanical Engineers, Part L: Journal of Materials: Design and Applications*, **232**(8), 625-636.
Habibi, M., Hashemi, R., Sadeghi, E., Fazaeli, A., Ghazanfari, A. and Lashini, H. (2016), "Enhancing the mechanical properties and formability of low carbon steel with dual-phase microstructures", *J. Mater. Eng. Perform*., **25**(2), 382-389.
Habibi, M., Hashemi, R., Tafti, M.F. and Assempour, A. (2018b), "Experimental investigation of mechanical properties, formability and forming limit diagrams for tailor-welded blanks produced by friction stir welding", *J. Manuf. Pr*., **31**, 310-323.
Habibi, M., Mohammadgholiha, M. and Safarpour, H. (2019b), "Wave propagation characteristics of the electrically GNP-reinforced nanocomposite cylindrical shell", *Journal of the Brazilian Society of Mechanical Sciences and Engineering*. **41**(5), 221. https://doi.org/10.1007/s40430-019-1715-x
Habibi, M., Mohammadi, A., Safarpour, H. and Ghadiri, M. (2019c), "Effect of porosity on buckling and vibrational characteristics of the imperfect GPLRC composite nanoshell", *Mech. Based Des. Struct*., 1-30. https://doi.org/10.1080/15397734.2019.1701490.

Habibi, M., Mohammadi, A., Safarpour, H., Shavalipour, A. and Ghadiri, M. (2019d), "Wave propagation analysis of the laminated cylindrical nanoshell coupled with a piezoelectric actuator", *Mech. Based Des. Struct.*, 1-19. https://doi.org/10.1080/15397734.2019.1697932

Habibi, M., Safarpour, M. and Safarpour, H. (2020), "Vibrational characteristics of a FG-GPLRC viscoelastic thick annular plate using fourth-order Runge-Kutta and GDQ methods", *Mech. Based Des. Struct.*, 1-22. https://doi.org/10.1080/15397734.2020.1779086

Habibi, M., Taghdir, A. and Safarpour, H. (2019e), "Stability analysis of an electrically cylindrical nanoshell reinforced with graphene nanoplatelets", *Compos. Part B Eng.*, **175**, 107125. https://doi.org/10.1016/j.compositesb.2019.107125

Hashemi, H.R., Alizadeh, A.a., Oyarhossein, M.A., Shavalipour, A., Makkiabadi, M. and Habibi, M. (2019), "Influence of imperfection on amplitude and resonance frequency of a reinforcement compositionally graded nanostructure", *Wave Random Complex Med.*, 1-27. https://doi.org/10.1080/17455030.2019.1662968

He, X., Ding, J., Habibi, M., Safarpour, H. and Safarpour, M. (2021), "Non-polynomial framework for bending responses of the multi-scale hybrid laminated nanocomposite reinforced circular/annular plate", *Thin Wall. Struct.*, **166**, 108019. https://doi.org/10.1016/j.tws.2021.108019

Hou, S., Qiao, L. and Xing, L. (2022), "Artificial neural fuzzy system and monitoring the process via IoT for optimization synthesis of nano-size polymeric chains", *Adv. Nano Res.*, **12**(4), 375-386. https://doi.org/10.12989/ANR.2022.12.4.375

Huang, X., Hao, H., Oslub, K., Habibi, M. and Tounsi, A. (2021), "Dynamic stability/instability simulation of the rotary size-dependent functionally graded microsystem", *Eng. Comput.*, 1-17. https://doi.org/10.1007/s00366-021-01399-3

Iadicola, M.A. and Banerjee, D.K. (2019). "A design of experiments approach for determining sensitivities of forming limit analyses to experimental parameters", *Mech.Biol. Syst. Micro Nanomech.*, **4**.

Igali, D., Wei, D., Zhang, D. and Perveen, A. (2020), "A comparative analysis of sheeting die geometries using numerical simulations", *Adv. Comput. Des.*, **5**(2), 111-125. https://doi.org/10.12989/acd.2020.5.2.111

Janssen, P., De Keijser, T.H. and Geers, M. (2006), "An experimental assessment of grain size effects in the uniaxial straining of thin Al sheet with a few grains across the thickness", *Mater. Sci. Eng. A*, **419**(1-2), 238-248. https://doi.org/10.1016/j.msea.2005.12.029

Jiang, C., Zheng, Y., Wang, D., Zheng, Y., Xie, C., Shi, L., Liu, Z. and Tang, Y. (2022), "Unusual size effect in ion and charge transport in micron-sized particulate aluminum anodes of lithium-ion batteries", *Angewandte Chemie Int.*, e202208370. https://doi.org/10.1002/anie.202208370

Kesornsit, W. and Sirisathitkul, Y. (2022), "Water consumption prediction based on machine learning methods and public data", *Adv. Comput. Des.*, **7**(2), 113-128. https://doi.org/10.12989/acd.2022.7.2.113

Kong, F., Dong, F., Duan, M., Habibi, M., Safarpour, H. and Tounsi, A. (2022), "On the vibrations of the Electrorheological sandwich disk with composite face sheets considering pre and post-yield regions", *Thin Wall. Struct.*, **179**, 109631. https://doi.org/10.1016/j.tws.2022.109631

Kotkunde, N., Deole, A.D. and Gupta, A.K. (2014), "Prediction of forming limit diagram for Ti-6Al-4V alloy using artificial neural network", *Procedia Mater. Sci.*, **6**, 341-346. https://doi.org/10.1016/j.mspro.2014.07.043

Kumar, S.P., S.Elangovan and R.Mohanraj (2020), "Experimental study on single point incremental forming of Inconel 718", *Transactions of the Canadian Society for Mechanical Engineering*, **44**(2), 179-188. https://doi.org/10.1139/tcsme-2018-0273

Lande, B. and Mitzner, W. (2006), "Analysis of lung parenchyma as a parametric porous medium", *J. Appl. Physiol.*, **101**(3), 926-933. https://doi.org/10.1152/japplphysiol.01548.2005

Li, J., Cheng, F., Lin, G. and Wu, C. (2022), "Improved hybrid method for the generation of ground motions compatible with the multi-damping design spectra", *J. Earthq. Eng.*, 1-27. https://doi.org/10.1080/13632469.2022.2095059

Li, J., Tang, F. and Habibi, M. (2020a), "Bi-directional thermal buckling and resonance frequency characteristics of a GNP-reinforced composite nanostructure", *Eng. Comput.*, 1-22. https://doi.org/10.1007/s00366-020-01110-y

Li, Y., Li, S., Guo, K., Fang, X. and Habibi, M. (2020b), "On the modeling of bending responses of graphene-reinforced higher order annular plate via two-dimensional continuum mechanics approach", *Eng. Comput.*, 1-22. https://doi.org/10.1007/s00366-020-01166-w

Liang, L., Xu, M., Chen, Y., Zhang, T., Tong, W., Liu, H., Wang, H. and Li, H. (2021), "Effect of welding thermal treatment on the microstructure and mechanical properties of nickel-based superalloy fabricated by selective laser melting", *Mater. Sci. Eng. A*, **819**, 141507. https://doi.org/10.1016/j.msea.2021.141507

Liu, H., Shen, S., Oslub, K., Habibi, M. and Safarpour, H. (2021a), "Amplitude motion and frequency simulation of a composite viscoelastic microsystem within modified couple stress elasticity", *Eng. Comput.*, 1-15. https://doi.org/10.1007/s00366-021-01316-8

Liu, H., Zhao, Y., Pishbin, M., Habibi, M., Bashir, M. and Issakhov, A. (2021b), "A comprehensive mathematical simulation of the composite size-dependent rotary 3D microsystem via two-dimensional generalized differential quadrature method", *Eng. Comput.*, 1-16. https://doi.org/10.1007/s00366-021-01419-2

Liu, K., Ke, F., Huang, X., Yu, R., Lin, F., Wu, Y. and Ng, D.W.K. (2021c), "Deepban: A temporal convolution-based communication framework for dynamic WBANS", *IEEE T Commun.*, **69**(10), 6675-6690. https://doi.org/10.1109/TCOMM.2021.3094581

Liu, Z., Su, S., Xi, D. and Habibi, M. (2020a), "Vibrational responses of a MHC viscoelastic thick annular plate in thermal environment using GDQ method", *Mech. Based Des. Struct.*, 1-26. https://doi.org/10.1080/15397734.2020.1784201

Liu, Z., Wu, X., Yu, M. and Habibi, M. (2020b), "Large-amplitude dynamical behavior of multilayer graphene platelets reinforced nanocomposite annular plate under thermo-mechanical loadings", *Mech. Based Des. Struct.*, 1-25. https://doi.org/10.1080/15397734.2020.1815544

Lori, E.S., Ebrahimi, F., Supeni, E.E.B., Habibi, M. and Safarpour, H. (2020), "The critical voltage of a GPL-reinforced composite microdisk covered with piezoelectric layer", *Eng. Comput.*, 1-20. https://doi.org/10.1007/s00366-020-01004-z

Lu, S., Ban, Y., Zhang, X., Yang, B., Liu, S., Yin, L. and Zheng, W. (2022), "Adaptive control of time delay teleoperation system with uncertain dynamics", *Front. Neurorobot.*, **16**, 928863-928863. https://doi.org/10.3389/fnbot.2022.928863

Luo, G., Yuan, Q., Li, J., Wang, S. and Yang, F. (2022a), "Artificial intelligence powered mobile networks: From cognition to decision", *IEEE Network*, **36**(3), 136-144. https://doi.org/10.1109/MNET.013.2100087

Luo, G., Zhang, H., Yuan, Q., Li, J. and Wang, F.-Y. (2022b), "ESTNet: Embedded spatial-temporal network for modeling traffic flow dynamics", *IEEE T Intell. Transp. Syst.*, **23**(10), 19201-19212. https://doi.org/10.1109/TITS.2022.3167019

Luo, J., Wu, S., Hou, S., Moradi, Z., Habibi, M. and Khadimallah, M.A. (2022c), "Thermally nonlinear thermoelasticity of a onedimensional finite domain based on the finite strain concept", *Eur. J. Mech. A Solids*., 104726. https://doi.org/10.1016/j.euromechsol.2022.104726

Mazloom, M. and Mirzamohammadi, S. (2021), "Computing the fracture energy of fiber reinforced cementitious composites using response surface methodology", *Adv. Comput. Des*., **6**(3), 225-239. https://doi.org/10.12989/acd.2021.6.3

Mirsalehi, M., Azhari, M. and Amoushahi, H. (2017), "Buckling and free vibration of the FGM thin micro-plate based on the modified strain gradient theory and the spline finite strip method", *Eur. J. Mech. A Solids*., **61**, 1-13. https://doi.org/10.1016/j.euromechsol.2016.08.008

Moayedi, H., Aliakbarlou, H., Jebeli, M., Noormohammadiarani, O., Habibi, M., Safarpour, H. and Foong, L. (2020a), "Thermal buckling responses of a graphene reinforced composite micropanel structure", *Int. J. Appl. Mech*., **12**(1), 2050010. https://doi.org/10.1142/S1758825120500106

Moayedi, H., Ebrahimi, F., Habibi, M., Safarpour, H. and Foong, L.K. (2020b), "Application of nonlocal strain–stress gradient theory and GDQEM for thermo-vibration responses of a laminated composite nanoshell", *Eng. Comput*., 1-16. https://doi.org/10.1007/s00366-020-01002-1

Moayedi, H., Habibi, M., Safarpour, H., Safarpour, M. and Foong, L. (2019), "Buckling and frequency responses of a graphene nanoplatelet reinforced composite microdisk", *International J. Appl. Mech*., **11**(10), 1950102. https://doi.org/10.1142/S1758825119501023

Mohammadgholiha, M., Shokrgozar, A., Habibi, M. and Safarpour, H. (2019), "Buckling and frequency analysis of the nonlocal strain–stress gradient shell reinforced with graphene nanoplatelets", *J. Vib. Control*, **25**(19-20), 2627-2640. https://doi.org/10.1177/1077546319863251

Mohammadi, A., Lashini, H., Habibi, M. and Safarpour, H. (2019), "Influence of viscoelastic foundation on dynamic behaviour of the double walled cylindrical inhomogeneous micro shell using MCST and with the aid of GDQM", *J. Solid Mech*., **11**(2), 440-453. https://doi.org/10.22034/JSM.2019.665264

Moradi, H., Atashi, P., Amelirad, O., Yang, J.-K., Chang, Y.-Y. and Kamranifard, T. (2022), "Machine learning modeling and DOE-assisted optimization in synthesis of nanosilica particles via Stöber method", *Adv. Nano Res*., **12**(4), 387-403. https://doi.org/10.12989/anr.2022.12.4.387

Naik, B.S., Ramulu, P.J. and Narayanan, R.G. (2010), "Application of a few necking criteria in predicting the forming limit of unwelded and tailor-welded blanks", *J. Strain Anal. Eng. Des*., **45**(2), 79-96. https://doi.org/10.1243/03093247JSA562

Najaafi, N., Jamali, M., Habibi, M., Sadeghi, S., Jung, D.w. and Nabipour, N. (2020), "Dynamic instability responses of the substructure living biological cells in the cytoplasm environment using stress-strain size-dependent theory", *J. Biomol. Struct. Dyn*., 1-12. https://doi.org/10.1080/07391102.2020.1751297

Noell, P., Carroll, J., Hattar, K., Clark, B. and Boyce, B. (2017), "Do voids nucleate at grain boundaries during ductile rupture?", *Acta Materialia*, **137**, 103-114. https://doi.org/10.1016/j.actamat.2017.07.004

Oyarhossein, M.A., Alizadeh, A.a., Habibi, M., Makkiabadi, M., Daman, M., Safarpour, H. and Jung, D.W. (2020), "Dynamic response of the nonlocal strain-stress gradient in laminated polymer composites microtubes", *Sci. Rep*., **10**(1), 1-19. https://doi.org/10.1038/s41598-020-61855-w

Park, J.W. and Shin, K.S. (2017), "Improved stretch formability of AZ31 sheet via grain size control", *Mater. Sci. Eng. A*, **688**, 56-61. https://doi.org/10.1016/j.msea.2017.01.101

Pourjabari, A., Hajilak, Z.E., Mohammadi, A., Habibi, M. and Safarpour, H. (2019), "Effect of porosity on free and forced vibration characteristics of the GPL reinforcement composite nanostructures", *Comput. Math. Appl*., **77**(10), 2608-2626. https://doi.org/10.1038/s41598-020-61855-w

Querin, J., Schneider, J. and Horstemeyer, M. (2007), "Analysis of micro void formation at grain boundary triple points in monotonically strained AA6022-T43 sheet metal", *Mater. Sci. Eng. A*, **463**(1-2), 101-106. https://doi.org/10.1016/j.msea.2006.10.167

Safaei, B., Khoda, F.H. and Fattahi, A. (2019), "Non-classical plate model for single-layered graphene sheet for axial buckling", *Adv. Nano Res*., **7**(4), 265-275.

Safarpour, H., Ghanizadeh, S.A. and Habibi, M. (2018), "Wave propagation characteristics of a cylindrical laminated composite nanoshell in thermal environment based on the nonlocal strain gradient theory", *Eur. Phys. J. Plus*, **133**(12), 532.

Safarpour, H., Hajilak, Z.E. and Habibi, M. (2019a), "A size-dependent exact theory for thermal buckling, free and forced vibration analysis of temperature dependent FG multilayer GPLRC composite nanostructures restring on elastic foundation", *Int. J. Mech. Mater. Des*., **15**(3), 569-583.

Safarpour, H., Pourghader, J. and Habibi, M. (2019b), "Influence of spring-mass systems on frequency behavior and critical voltage of a high-speed rotating cantilever cylindrical three-dimensional shell coupled with piezoelectric actuator", *J. Vib. Control*, **25**(9), 1543-1557. https://doi.org/10.1177/1077546319828465

Safarpour, M., Ebrahimi, F., Habibi, M. and Safarpour, H. (2020), "On the nonlinear dynamics of a multi-scale hybrid nanocomposite disk", *Eng. Comput*., 1-20. https://doi.org/10.1007/s00366-020-00949-5

Shang, X., Zhang, H., Cui, Z., Fu, M. and Shao, J. (2019), "A multiscale investigation into the effect of grain size on void evolution and ductile fracture: Experiments and crystal plasticity modeling", *Int. J. Plastic*., **125**, 133-149. https://doi.org/10.1016/j.ijplas.2019.09.009

Shao, Y., Zhao, Y., Gao, J. and Habibi, M. (2021), "Energy absorption of the strengthened viscoelastic multi-curved composite panel under friction force", *Arch. Civil Mech. Eng*., **21**(4), 1-29. https://doi.org/10.1007/s43452-021-00279-3

Shariati, A., Habibi, M., Tounsi, A., Safarpour, H. and Safa, M. (2020a), "Application of exact continuum size-dependent theory for stability and frequency analysis of a curved cantilevered microtubule by considering viscoelastic properties", *Eng. Comput*., 1-20. https://doi.org/10.1007/s00366-020-01024-9

Shariati, A., Mohammad-Sedighi, H., Żur, K.K., Habibi, M. and Safa, M. (2020b), "On the vibrations and stability of moving viscoelastic axially functionally graded nanobeams", *Materials*, **13**(7), 1707. https://doi.org/10.3390/ma13071707

Shariati, A., Mohammad-Sedighi, H., Żur, K.K., Habibi, M. and Safa, M. (2020c), "Stability and dynamics of viscoelastic moving rayleigh beams with an asymmetrical distribution of material parameters", *Symmetry*, **12**(4), 586. https://doi.org/10.3390/sym12040586

Shariati, M., Azar, S.M., Arjomand, M.-A., Tehrani, H.S., Daei, M. and Safa, M. (2020d), "Evaluating the impacts of using piles and geosynthetics in reducing the settlement of fine-grained soils under static load", *Geomech. Eng*., **20**(2), 87-101. https://doi.org/10.12989/gae.2020.20.2.087

Shariati, M., Davoodnabi, S.M., Toghroli, A., Kong, Z. and Shariati, A. (2021a), "Hybridization of metaheuristic algorithms with adaptive neuro-fuzzy inference system to predict load-slip behavior of angle shear connectors at elevated temperatures", *Compos. Struct*., 114524. https://doi.org/10.1016/j.compstruct.2021.114524

Shariati, M., Faegh, S.S., Mehrabi, P., Bahavarnia, S., Zandi, Y., Masoom, D.R., Toghroli, A., Trung, N.-T. and Salih, M.N. (2019), "Numerical study on the structural performance of corrugated low yield point steel plate shear walls with circular openings", *Steel Compos. Struct.*, **33**(4), 569-581. https://doi.org/10.12989/scs.2019.33.4.569

Shariati, M., Ghorbani, M., Naghipour, M., Alinejad, N. and Toghroli, A. (2020e), "The effect of RBS connection on energy absorption in tall buildings with braced tube frame system", *Steel Compos. Struct.*, **34**(3), 393-407. https://doi.org/10.12989/scs.2020.34.3.393

Shariati, M., Lagzian, M., Maleki, S., Shariati, A. and Trung, N.T. (2020f), "Evaluation of seismic performance factors for tension-only braced frames", *Steel Compos. Struct.*, **35**(4), 599-609. https://doi.org/10.12989/scs.2020.35.4.599

Shariati, M., Mafipour, M.S., Ghahremani, B., Azarhomayun, F., Ahmadi, M., Trung, N.T. and Shariati, A. (2020g), "A novel hybrid extreme learning machine–grey wolf optimizer (ELM-GWO) model to predict compressive strength of concrete with partial replacements for cement", *Eng. Comput.*, 1-23. https://doi.org/10.1007/s00366-020-01081-0

Shariati, M., Mafipour, M.S., Mehrabi, P., Ahmadi, M., Wakil, K., Trung, N.T. and Toghroli, A. (2020h), "Prediction of concrete strength in presence of furnace slag and fly ash using Hybrid ANN-GA (Artificial Neural Network-Genetic Algorithm)", *Smart Struct. Syst.*, **25**(2), 183-195. https://doi.org/10.12989/sss.2020.25.2.183

Shariati, M., Naghipour, M., Yousofizinsaz, G., Toghroli, A. and Tabarestani, N.P. (2020i), "Numerical study on the axial compressive behavior of built-up CFT columns considering different welding lines", *Steel Compos. Struct*. **34**(3), 377-391. http://doi.org/10.12989/scs.2020.34.3.377

Shariati, M., Shariati, A., Trung, N.T., Shoaei, P., Ameri, F., Bahrami, N. and Zamanabadi, S.N. (2021b), "Alkali-activated slag (AAS) paste: Correlation between durability and microstructural characteristics", *Constr. Build. Mater.*, **267**, 120886. https://doi.org/10.1016/j.conbuildmat.2020.120886

Shariati, M., Sulong, N.R. and Khanouki, M.A. (2012), "Experimental assessment of channel shear connectors under monotonic and fully reversed cyclic loading in high strength concrete", *Mater. Des.*, **34**, 325-331. https://doi.org/10.1016/j.matdes.2011.08.008

Shariati, M., Sulong, N.R., Shariati, A. and Khanouki, M.A. (2016a), "Behavior of V-shaped angle shear connectors: experimental and parametric study", *Mater. Struct.*, **49**(9), 3909-3926. https://doi.org/10.1617/s11527-015-0762-8

Shariati, M., Sulong, N.R., Shariati, A. and Kueh, A. (2016b), "Comparative performance of channel and angle shear connectors in high strength concrete composites: An experimental study", *Constr. Build. Mater.*, **120**, 382-392. https://doi.org/10.1016/j.conbuildmat.2016.05.102

Shariati, M., Tahmasbi, F., Mehrabi, P., Bahadori, A. and Toghroli, A. (2020j), "Monotonic behavior of C and L shaped angle shear connectors within steel-concrete composite beams: An experimental investigation", *Steel Compos Struct.*, **35**(2), 237-247. http://doi.org/10.12989/scs.2020.35.2.237

Shokrgozar, A., Safarpour, H. and Habibi, M. (2020), "Influence of system parameters on buckling and frequency analysis of a spinning cantilever cylindrical 3D shell coupled with piezoelectric actuator", *Proceedings of the Institution of Mechanical Engineers, Part C: Journal of Mechanical Engineering Science*, **234**(2), 512-529. https://doi.org/10.1177/0954406219883312

Singh, A.V., Ansari, M.H.D., Rosenkranz, D., Maharjan, R.S., Kriegel, F.L., Gandhi, K., Kanase, A., Singh, R., Laux, P. and Luch, A. (2020a), "Artificial intelligence and machine learning in computational nanotoxicology: Unlocking and empowering nanomedicine", *Adv. Healthcare Mater.*, **9**(17), 1901862. https://doi.org/10.1002/adhm.201901862

Singh, A.V., Rosenkranz, D., Ansari, M.H.D., Singh, R., Kanase, A., Singh, S.P., Johnston, B., Tentschert, J., Laux, P. and Luch, A. (2020b), "Artificial intelligence and machine learning empower advanced biomedical material design to toxicity prediction", *Adv. Intell. Syst.*, **2**(12), 2000084. https://doi.org/10.1002/aisy.202000084

Thinakaran, K., Rajasekar, R., Santhi, K. and Nalini, M. (2020), "Predicting the 2-dimensional airfoil by using machine learning methods", *Adv. Comput. Des.*, **5**(3), 291-304. https://doi.org/10.12989/acd.2020.5.3.291

Vakondios, D.G. and Kyratsis, P. (2020), "An innovative CAD-based simulation of ball-end milling in microscale", *Adv. Comput. Des.*, **5**(1), 13-34. https://doi.org/10.12989/acd.2020.5.1.013

Wang, H., Habibi, M., Marzouki, R., Majdi, A., Shariati, M., Denic, N., Zakić, A., Khorami, M., Khadimallah, M.A. and Ebid, A.A.K. (2022a), "Improving the self-healing of cementitious materials with a hydrogel system", *Gels*, **8**(5), 278. https://doi.org/10.3390/gels8050278

Wang, J., Liang, F., Zhou, H., Yang, M. and Wang, Q. (2022b), "Analysis of position, pose and force decoupling characteristics of a 4-UPS/1-RPS parallel grinding robot", *Symmetry*, **14**(4), 825. https://doi.org/10.3390/sym14040825

Wang, W., Yuan, X., Wu, X. and Liu, Y. (2017), "Fast image dehazing method based on linear transformation", *IEEE T Multimed.*, **19**(6), 1142-1155. https://doi.org/10.1109/TMM.2017.2652069

Wang, Z., Yu, S., Xiao, Z. and Habibi, M. (2020), "Frequency and buckling responses of a high-speed rotating fiber metal laminated cantilevered microdisk", *Mech. Adv. Mater. Struct.*, 1-14. https://doi.org/10.1080/15376494.2020.1824284

Wu, J. and Habibi, M. (2021), "Dynamic simulation of the ultra-fast-rotating sandwich cantilever disk via finite element and semi-numerical methods", *Eng. Comput.*, 1-17. https://doi.org/10.1007/s00366-021-01396-6

Wu, Y., Chen, J., Zhang, L., Ji, J., Wang, Q. and Zhang, S. (2022), "Effect of boron on the structural stability, mechanical properties, and electronic structures of γ′-Ni3Al in TLP joints of nickel-based single-crystal alloys", *Mater. Today Commun.*, **31**, 103375. https://doi.org/10.1016/j.mtcomm.2022.103375

Xia, W., Du, J., Habibi, M., Shariati, M. and Khadimallah, M.A. (2022), "Application of Chebyshev-based GDQ and Newmark methods to viscothermoelasticity responses of FG composite annular systems", *Eng. Anal. Bound. Elem.*, **143**, 28-42. https://doi.org/10.1016/j.enganabound.2022.06.003

Xiong, Q.M., Chen, Z., Huang, J.T., Zhang, M., Song, H., Hou, X.F., Li, X.B. and Feng, Z.J. (2020), "Preparation, structure and mechanical properties of Sialon ceramics by transition metal-catalyzed nitriding reaction", *Rare Metals*, **39**(5), 589-596.

Xu, Y., Chen, X., Zhang, H., Yang, F., Tong, L., Yang, Y., Yan, D., Yang, A., Yu, M. and Liu, Z. "Online identification of battery model parameters and joint state of charge and state of health estimation using dual particle filter algorithms", *Int. J. Energy Res.*, **46**(14), 19615-19652. https://doi.org/10.1002/er.8541

Yang, L., Dai, Q., Liu, L., Shao, D., Luo, K., Jamil, S., Liu, H., Luo, Z., Chang, B. and Wang, X. (2020), "Rapid sintering method for highly conductive Li7La3Zr2O12 ceramic electrolyte", *Ceram. Int.*, **46**(8), 10917-10924. https://doi.org/10.1016/j.ceramint.2020.01.106

Zadpoor, A.A., Sinke, J. and Benedictus, R. (2009), "Finite element modeling and failure prediction of friction stir welded blanks", *Mater. Des.*, **30**(5), 1423-1434. https://doi.org/10.1016/j.matdes.2008.08.018

Zadpoor, A.A., Sinke, J., Benedictus, R. and Pieters, R. (2008), "Mechanical properties and microstructure of friction stir welded tailor-made blanks", *Mater. Sci. Eng. A*, **494**(1-2), 281-290. https://doi.org/10.1016/j.msea.2008.04.042

Zare, R., Najaafi, N., Habibi, M., Ebrahimi, F. and Safarpour, H.

(2020), "Influence of imperfection on the smart control frequency characteristics of a cylindrical sensor-actuator GPLRC cylindrical shell using a proportional-derivative smart controller", *Smart Struct. Syst.*, **26**(4), 469-480. https://doi.org/10.12989/sss.2020.26.4.469

Zhang, L., Min, J., Carsley, J.E., Stoughton, T.B. and Lin, J. (2017), "Experimental and theoretical investigation on the role of friction in Nakazima testing", *Int. J. Mech. Sci.*, **133**, 217-226. https://doi.org/10.1016/j.ijmecsci.2017.08.020

Zhang, L. and Wang, J. (2012), "Modeling the localized necking in anisotropic sheet metals", *Int. J. Plast.*, **39**, 103-118. https://doi.org/10.1016/j.ijplas.2012.05.005

Zhang, Y., Wang, Z., Tazeddinova, D., Ebrahimi, F., Habibi, M. and Safarpour, H. (2021), "Enhancing active vibration control performances in a smart rotary sandwich thick nanostructure conveying viscous fluid flow by a PD controller", *Wave Random Complex Med.*, 1-24. https://doi.org/10.1080/17455030.2021.1948627

Zhang, Z., Luo, C. and Zhao, Z. (2020), "Application of probabilistic method in maximum tsunami height prediction considering stochastic seabed topography", *Natural Hazards*, **104**(3), 2511-2530. https://doi.org/10.1007/s11069-020-04283-3

Zhao, R., Dai, H. and Yao, H. (2022a), "Liquid-metal magnetic soft robot with reprogrammable magnetization and stiffness", *IEEE Robot. Automat. Lett.*, **7**(2), 4535-4541. https://doi.org/10.1109/LRA.2022.3151164

Zhao, W., Suo, H., Wang, S., Ma, L., Wang, L., Wang, Q. and Zhang, Z. (2022b), "Mg gas infiltration for the fabrication of MgB2 pellets using nanosized and microsized B powders", *J. Eur. Ceram. Soc.*, **42**(15), 7036-7048. https://doi.org/10.1016/j.jeurceramsoc.2022.08.029

Zhou, C., Zhao, Y., Zhang, J., Fang, Y. and Habibi, M. (2020), "Vibrational characteristics of multi-phase nanocomposite reinforced circular/annular system", *Adv. Nano Res.*, **9**(4), 295-307. https://doi.org/10.12989/anr.2020.9.4.295

Zhou, X., Wang, P., Al-Dhaifallah, M., Rawa, M. and Khadimallah Mohamed, A. (2022), "A machine learning-based model for the estimation of the critical thermo-electrical responses of the sandwich structure with magneto-electro-elastic face sheet", *Adv. Nano Res.*, **12**(1), 81-99. https://doi.org/10.12989/anr.2022.12.1.081

Zhu, H. and Zhao, R. (2022), "Nucleation of CVD-prepared hexagonal boron nitride on Ni (100), Ni (110) and Ni (111) surfaces: A theoretical study", *Vacuum*, 111396. https://doi.org/10.1016/j.vacuum.2022.111396

Zhu, L., Ren, H., Habibi, M., Mohammed, K.J. and Khadimallah, M.A. (2022), "Predicting the environmental economic dispatch problem for reducing waste nonrenewable materials via an innovative constraint multi-objective Chimp Optimization Algorithm", *J. Clean. Prod.*, 132697. https://doi.org/10.1016/j.jclepro.2022.132697

Zhu, Q., Wang, C., Qin, H., Chen, G. and Zhang, P. (2019), "Effect of the grain size on the microtensile deformation and fracture behaviors of a nickel-based superalloy via EBSD and in-situ synchrotron radiation X-ray tomography", *Mater. Character.*, **156**, 109875. https://doi.org/10.1016/j.matchar.2019.109875

Zuo, J. and Lin, X. (2022), "High-power laser systems", *Laser Photonics Rev.*, **16**(5), 2270025. https://doi.org/10.1002/lpor.202270025

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