Advances in Nano Research, *Vol. 14, No. 6 (2023) 527-539*
https://doi.org/10.12989/anr.2023.14.6.527

Evaluation of combat calorie consumption based on GoBe2 nanosensor

Shuo Guan and Benxu Zou*

Wushu and Dance Department, Shenyang Sport University, Shenyang 110102, Liaoning, China

(*Received January 17, 2022, Revised September 6, 2022, Accepted September 11, 2022*)

Abstract. Measuring energy burn during intensive combat sport has been a challenging concerns for a long time. In the present article, the energy consumption during combat sports is measured by use of wearable GoBe2 equipped with nano-technology measuring devices. In this regard, 12 professional combat athletes were asked to wear GoBe2 devices during different sessions of intensive combat exercises. The curves provided by GoBe2 nano-sensor devices are further collected and analyzed for different combat durations. On the other hand, energy consumption in these athlete is calculated using other validated methods to evaluate reliability of GoBe2 wearable devices. Based on the results obtained from these experiments a multi-parameter mathematical model is presented for estimation of combat calorie consumptions. The results show that nanotechnology in these type of sensors could help in estimation of calorie consumption during combat. Moreover, the reliability of using wearable GoBe2 sensors are satisfactory except for some specific conditions. The mathematical model provides a satisfactory results based on athlete physical condition and also duration of the combat with about 8% error margin in the results.
Keywords: artificial intelligence; combat calorie; energy consumption; fatigue; nanosensors

1. Introduction

Energy consumption during intensive sports is a major concerns for athletes and coaches in arranging exercises and food programs (Dai *et al*. 2023a, b, Peng *et al*. 2023, Sabzevari *et al*. 2023, Shariati *et al*. 2023, Xiang *et al*. 2023, Yang *et al*. 2023, Zhang *et al*. 2023, Zhao *et al*. 2023, Zheng *et al*. 2023). During the intensive actual sport during actual matches is a complex issue in contrast to controlled laboratory conditions due to unpredictable actions and movements. In combat sports, the condition is more complicated since the movement are totally based on the rival actions (Fazaeli *et al*. 2016, Habibi *et al*. 2017, 2019a, c, Safarpour *et al*. 2018, 2019b, 2020, Alipour *et al*. 2020, Ebrahimi *et al*. 2020a, Ghazanfari *et al*. 2020, Chen *et al*. 2022). Therefore, the conditions are totally different in laboratory with actual confrontation in a match (Silva *et al*. 2021). On the other hand, online monitoring of activity condition is not possible due to limitations in measuring devices. Thus, the role of wearable measuring and analysis devices having capability of saving data or online transferring data are extremely important specifically if these devices are light-weight and comfortable. The size and weight of these devices should allow athletes to perform their movements with minimal influence from these devices. Wearable measuring device based on nano-technologies are found to be advantageous in such applications (Habibi *et al*. 2016, 2018a, b, Ebrahimi *et al*. 2019a, Esmailpoor Hajilak *et al*. 2019, Habibi *et al*. 2019b, d, e, Pourjabari *et al*. 2019, Safarpour *et al*. 2019a, Zhu *et al*. 2022, Dai *et al*. 2023b, Zheng *et al*. 2023).

Nanotechnology-based devices facilitates several aspects of our daily lives in comparison to decades ago (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, Shariati *et al*. 2020a, b, Oyarhossein *et al*. 2020, Shokrgozar *et al*. 2020). The very first applications of nano-structured materials were found in composite material for the aim of structural applications. Other than extraordinary mechanical properties of nano-structures, thermal and electrical properties have been also the center of attentions for many years (Hashemi *et al*. 2019, 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). Thermal and electrical conductivity of nano-structures could be altered with slight changes in its structure from literally superconductive to semi-conductive and to nonconductive electrical structures. The same fact is applicable to thermal properties (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). From the beginning of recognizing astonishing properties of nano-materials, their utilization in different applications specifically in sensor designs (Adamian *et al*. 2020, Li *et al*. 2020b, Liu *et al*. 2020b, 2021b, Zare *et al*. 2020, Dai *et al*. 2021b, Habibi *et al*. 2021, He *et al*. 2021, Huang *et al*. 2021a, Zhang *et al*. 2021).

Due to their small-scale and light weight, nano-sensors have utilized in wearable sensor devices in different application. Health monitoring wearable sensor are widely being used nowadays for continuous checking the health state of patients (Wolbring and Leopatra 2013, Arai 2014, Fang *et al*. 2014). One another application, as mentioned above, is to measure energy consumption during exercises (Rossetto *et al*. 2012, RajaPavan *et al*. 2017). However, the applicability and accuracy of data from these devices are

*Corresponding author, Ph.D.,
E-mail: sygjws2017@163.com

ISSN: 2287-237X (Print), 2287-2388 (Online)

not fully understood and even their methods of measurements may be controversial. Nonetheless, these small wearable devices are used prevalently by amateur and even professional athletes to monitor their activity.

During exercises the heart rate increases and fluctuates depending on the level of intensiveness of the exercise. This parameter has been an appropriate measure for evaluating calorie burn in body in continuous exercises (Achten and Jeukendrup 2003). However, during an intermittent competitive match, it will result in totally different results with continuous treadmill experiment. (Silva *et al*. 2021). Silva *et al*. (2021) simulated futsal game to compare energy expenditure (EE) and volume of consumed oxygen (VO_2) with treadmill measurements. They found that there is significant difference between the results from laboratory measurements from those obtained in simulated games. It was discussed that anaerobic energy expenditure is a parameter which is less considered in the treadmill measurements while in a real match these energies could be accountable for almost 10% of energy expenditure. Compos *et al*. (2012) considered the energy consumption during a simulated Taekwondo combat taking into account effects of aerobic and anaerobic energy expenditure. They examined 10 Taekwondo athletes to measure oxygen consumption and evaluate energy expenditure. They found that the portion of alactic energy is near 45% of the aerobic energy expenditure. Therefore, it was suggested that specific attention should be paid to anaerobic energy consumption on combats. Beato *et al*. (2016) considered the recreational futsal matches as a way to improve public health. They measured the energy expenditure during recreational futsal match between 15 male participants. The total energy expenditure in a game was obtained to be near 630 kcal. This amount of energy is approximately equal to half of recommended energy burn in a week. Therefore, they suggested that two recreational match per week could aid public health status. It should be noted that energy expenditure was calculated using heart rate and VO_2 in their analyses. Effect of ambient temperature during exercise could not be neglected as explored in a study by Kriemler *et al*. (2002). They found that neglecting ambient temperature effect on the heart rate could results in near 3% of overestimation of EE using relations based on HR and VO_2 only. It is noteworthy that the mentioned study was based on daily life of a specific group. Therefore, their estimation for intensive exercises should be used with caution. Slimani *et al*. (2018) reviewed the heart rate changes in combat sports during both official and simulated matches. They found that HR increases significantly during the match regardless of the gender of the players. Moreover, Taekwondo was the most intensive combat sport among four sports considered in their review in term of increase in the HR. There are several studies on the energy expenditure in various situation in literature (Hou *et al*. 2021, Huang *et al*. 2021b, 2022, Jiao *et al*. 2021, Liu *et al*. 2021c, Ma *et al*. 2021, Moradi *et al*. 2021, Xu *et al*. 2021, Zhao *et al*. 2021, Dong *et al*. 2022, Fan *et al*. 2022a, b, Hu *et al*. 2022, Luo *et al*. 2022a, b, Michael *et al*. 2022, Moradi *et al*. 2022, Wang *et al*. 2022a, b, 2023, Yang *et al*. 2022a, b, Yu *et al*. 2022, Zhang *et al*. 2022, Zheng *et al*. 2022, Zhou *et al*. 2022a, b, Fang *et al*. 2023, Jin *et al*. 2023) Commercial devices for monitoring health status and energy expenditure are commonly used by athletes. However, there are limited published scientific studies shedding light on their reliability and accuracy. Wallén *et al*. (2012) examined one commercial wearable device to examine its accuracy in measuring heart rate variability in rest time. They claimed that the commercial device overestimated HR specifically in high HRs range. Gilgen-Ammann *et al*. (2021) studied the validation of HR and EE measurement during physical activity. They showed that all the investigated devices showed a satisfactory performance in monitoring HR. However, their capability in calculating EE was not acceptable.

Measuring energy burn during intensive combat sport has been a challenging concern for a long time (Zhu *et al*. 2017, Tao *et al*. 2021, Xu *et al*. 2022). In the present article, the energy consumption during combat sports is measured by use of wearable GoBe2 equipped with nano-technology measuring devices. In this regard, 12 professional combat athletes were asked to wear GoBe2 devices during different sessions of intensive combat exercises. The curves provided by GoBe2 nano-sensor devices are further collected and analyzed for different combat durations. On the other hand, energy consumption in these athlete are calculated using other validated methods to evaluate reliability of GoBe2 wearable devices. Based on the results obtained from these experiments a multi-parameter mathematical model is presented for estimation of combat calorie consumptions.

2. Methodology

2.1 Wearable measuring device

The wearable device selected for the present examination is GoBe2 by Healbe (Kreitmair 2019). A picture of this device is shown in Fig. 1. According to the official description of the device, this device uses a novel approach to measure calorie burn during activity by calculating change in skin impedance due to water outlet from the skin. Glucose produced from food eaten induce fluids to move to extracellular cells. Using their unique sensors, GoBe2 measure the calorie intake during 24 hours. Since, the fluid movement occurs hours after eating food, the instant measurement of calorie intake is impossible using this device. They claimed that the calorie intake measurement could reach 85% accuracy using this wearable device. However, the calorie consumption measurement is not clearly stated in the official documents while in the reports of the device applications calorie burn is also provided. Therefore, we aim to evaluate the accuracy of calorie consumption reported by GoBe2 in combat sport simulated matches.

2.2 Participants

In total, 10 boxing male athletes are asked to participate in the experiments in the present study. The participants had minimum 5 years continuous experience in the boxing. The

Fig. 1 GoBe2 wearable device from Healbe

participants were informed about the procedure of the experiment and their signed consents were acquired. The age of the participants are 22 ± 4.3 years (mean ± standard deviation). The weight of the participants are 76 ± 9.2kg and their height were 181 ± 5.1cm.

2.3 Experiments

Two categories of experiments were devised to measure the EE, HR and VO_2 of the athletes (Fu *et al*. 2020, Guo *et al*. 2022, Huang *et al*. 2023). First, they were asked to perform a treadmill training started at 9km/h speed and gradually increase with the rate of 1km/h/min to reach the maximum ability of the athlete. Two parameters HR and $VO2$ were measured to obtain the linear regression relation between these two parameters. Simultaneously, the data acquired from GoBe2 were recorded. Second, simulated combat matches were performed wearing GoBe2 device and with actual measurement of HR and VO_2 to compare the results. Each match were conducted in total 10min with 5 round of 2 min combat. The ambient temperature was between 26°C and 30°C. The calorie combustion of the athletes were calculated using the following formula:

$$EE = \frac{T}{4.184}(0.6309 \times HR + 0.1988 \times W - 0.2018 \times Age - 55.0969) \quad (1)$$

where, T stands for time duration of exercise and W is the weight of the athlete.

3. Results

3.1 Calorie consumption evaluations

The correlation between HR and VO_2 are measured using treadmill exercise for all 10 athletes and the results for four selected athletes are presented in Fig. 2 to have an insight into the relations. The linear regression between HR and VO_2 shows $VO_2 = 0.359HR - 11.3$ for all athletes. This linear relation will be utilized in all the next analyses. It is worth mentioning that the relations are seemed to be slightly nonlinear as in the high HRs the rate of VO_2 decreased to some level which may be correspond to the gaining maximum VO_2.

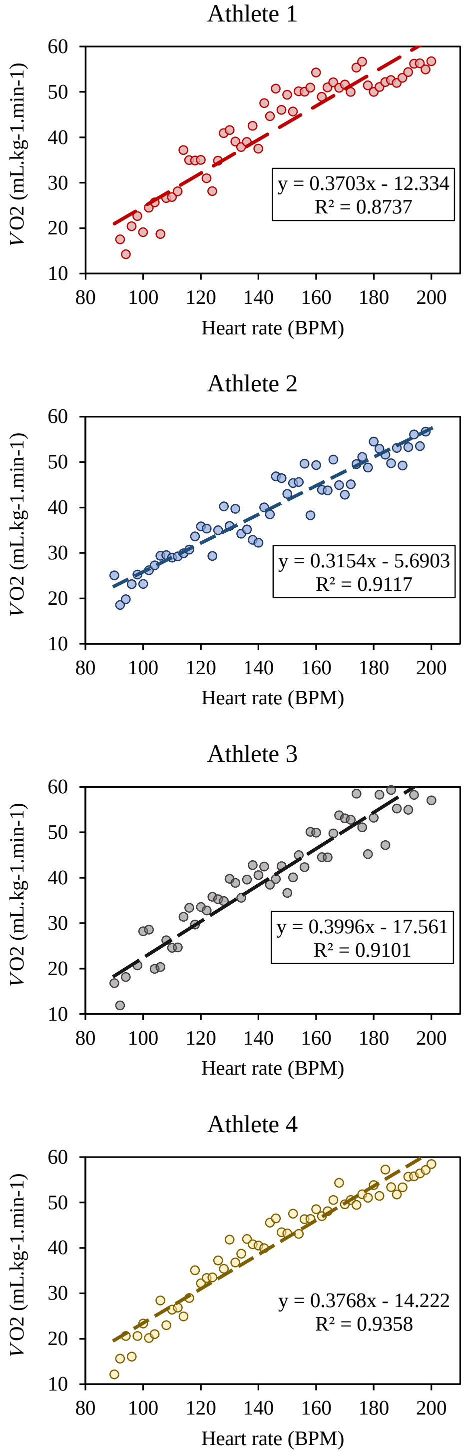


Fig. 2 Correlation between HR and VO_2 in treadmill exercise for four sample athletes

On the other hand, in the simulated combat match, the relation between HR and VO_2 measurements were more diverse with correlation factor not exceeding $R^2 = 0.46$, as shown in Fig. 3, in comparison to the correlation factor of treadmill exercise which has a minimum value of $R^2 = 0.87$. Therefore, there is a significant difference between actual match and treadmill exercise measurements in laboratory.

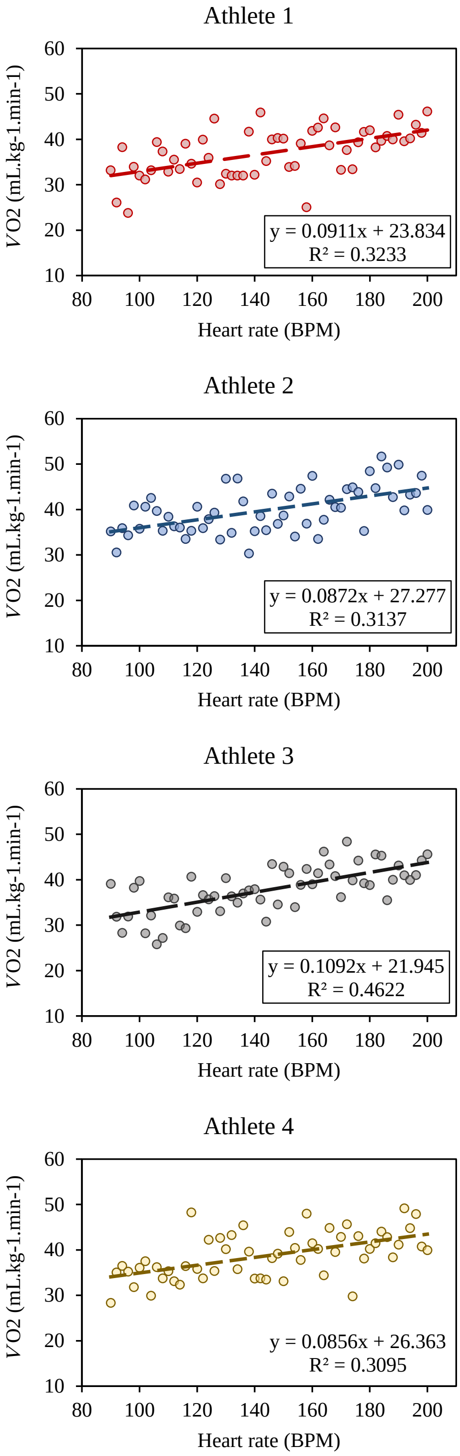


Fig. 3 Correlation between HR and VO_2 in simulated combat match for four sample athletes

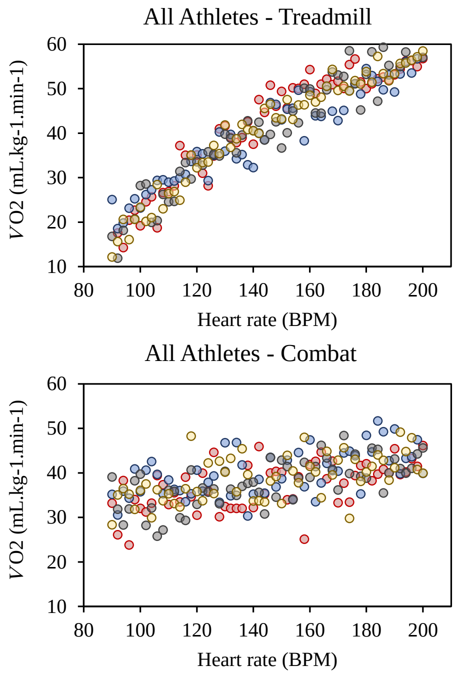
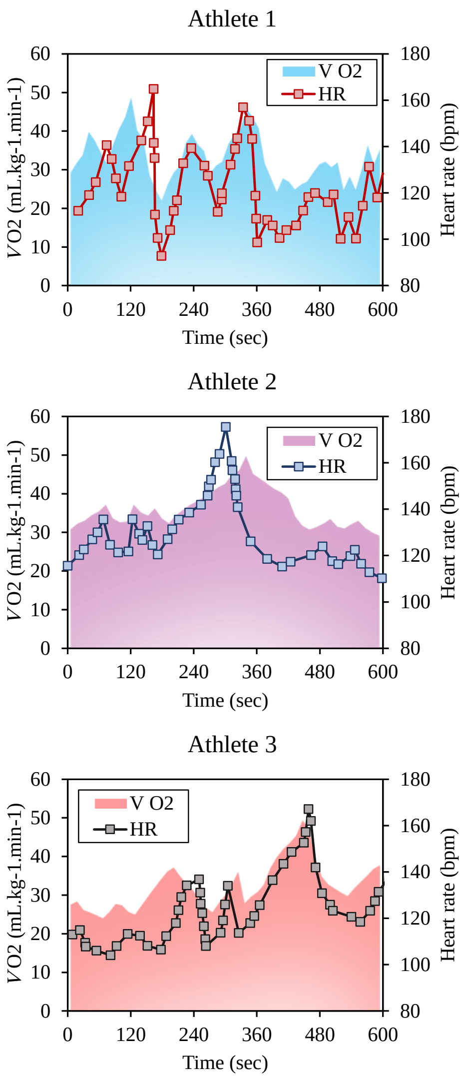


Fig. 4 Correlation between HR and VO_2 in (a) treadmill exercise (b) simulated combat match



All the data acquired from the athletes are gathered in one graph in Fig. 4 for both treadmill exercise and simulated combat match. As seen, an obvious nonlinearity is observed in the correlation between HR and VO_2 in treadmill exercise. On the other hand, the simulated combat match data shows a considerably diverse results which may be correspond change in HR rate due to stress level and dehydration.

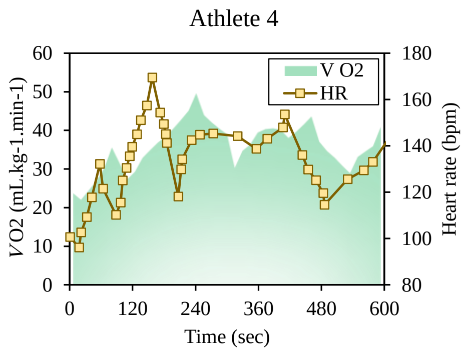


Fig. 5 HR and corresponding calculated VO_2 during simulated combat math for 10mim (600sec) time interval for four sample athletes.

Heart rate measurement during simulated combat match shows the intermittent nature of the combat exercise in contrast to treadmill exercise. As can be observed in Fig. 5, the heart rate change during combat could be very acute and change rapidly. Using the linear relation between HR and VO_2, curves of oxygen consumption is also depicted in these graphs for four sample athletes.

The main aim the present study is to compare the results of calorie consumption as reported by GoBe2 wearable device with the actual measurements and calculations. This comparison is demonstrated in Fig. 6 for four sample athletes. As seen the result from GoBe2 is far smoother than the actual measured values possibly indicating an averaging algorithm using by the device application to provide only the trend of the calorie burn during exercise. Nonetheless, the provided curves by GoBe2 wearable device show acceptable agreement in following energy consumption with respect to indicating minimum and maximum point quite accurately. However, the values of the maximum and minimum values differ from those provided by actual measurements. In most cases, the absolute values of GoBe2 is lower than measured. On another interesting fact about these curves is the measure of total energy expenditure during 10min which is overestimated by approximately 40% higher in comparison to the actual measurements. Therefore, caution should be exercised in using the data from this device in the case of calorie burned during exercise and double checking using another methods are recommended in the case of sensitive evaluations.

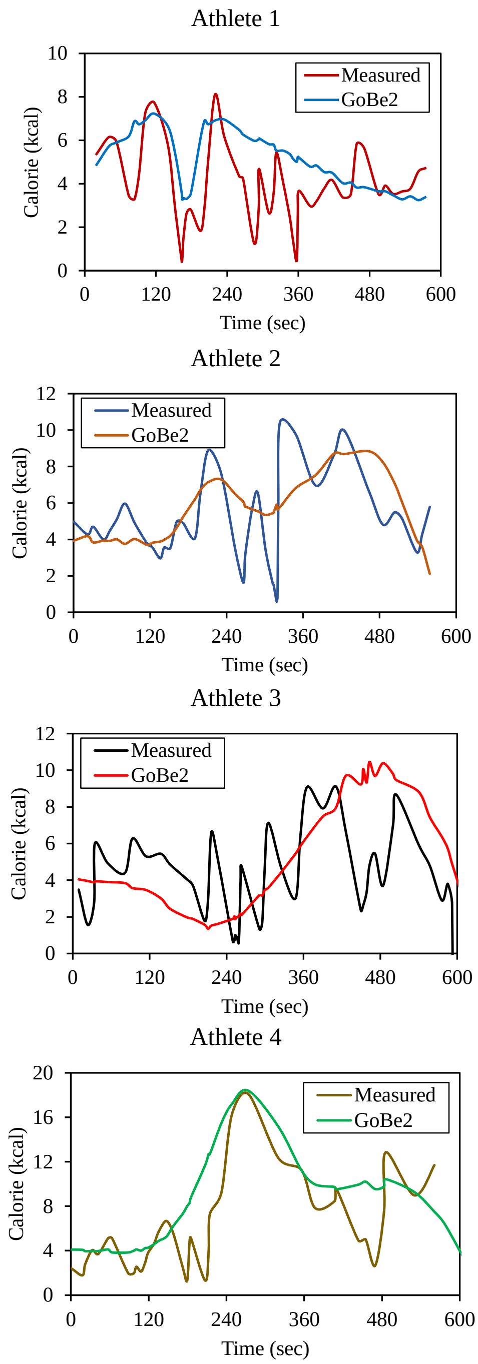


Fig. 6 Energy expenditure as calculated using laboratory devices as compared to data reported by GoBe2 for four sample athletes

3.2 Artificial neural network as a new path for calorie consumption calculations

As mentioned above, linear regression could not appropriately reflect the VO_2 parameter and calorie expenditure. On the other hand, there are several parameters affecting the condition of Energy expenditure in different exercises which may having extremely nonlinear influences. Therefore, using linear or even nonlinear regression could present inaccurate results. Artificial neural networks (ANNs) (Khanouki *et al*. 2016, Shah *et al*. 2015, 2016a, b, Shariati *et al*. 2018, 2020e, Mohammadhassani *et al*. 2013, 2014, Naghipour *et al*. 2020, Heydari and Shariati 2018, Chen *et al*. 2019, Luo *et al*. 2019, Xie *et al*. 2019, Razavian *et al*. 2020) have been proven to provide astonishing accurate results in complex problems with results couldn't be predicted with simple regression procedure. This method could be used in different fields of engineering and science as well as health care system. In this section we aim to present a designed ANN for predicting calorie consumption during an aerobic exercise from different information of the athlete and exercise intensity (Safa *et al*. 2019, Shariati *et al*. 2019a, 2020d, f, Suhatril *et al*. 2019, Jahandari *et al*. 2021).

The designed network is shown in Fig. 7 with 4 layers hidden layers. The input data is a set of various parameter

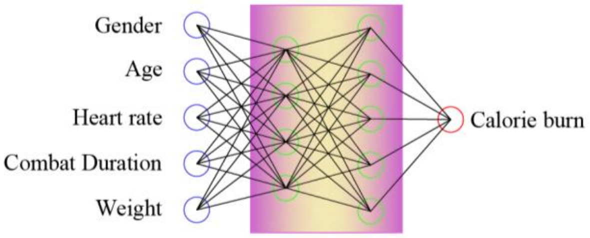


Fig. 7 Designed ANN for calculating calorie consumption in an exercise

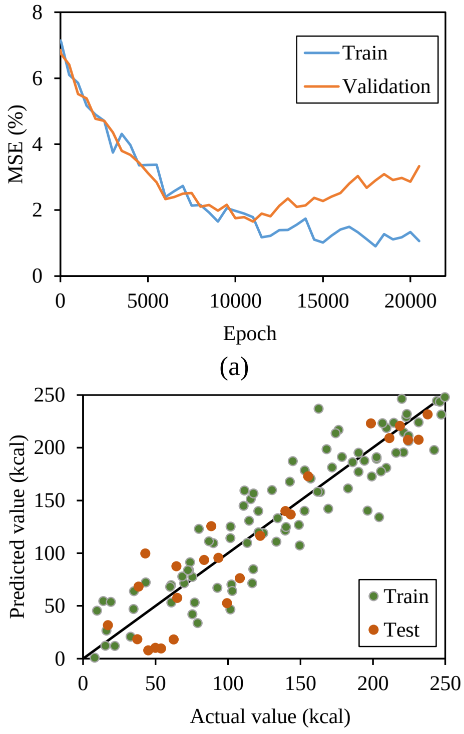


Fig. 8 (a) Artificial neural network training and validation error margin. (b) Predicted calorie consumptions in comparison to experimental results

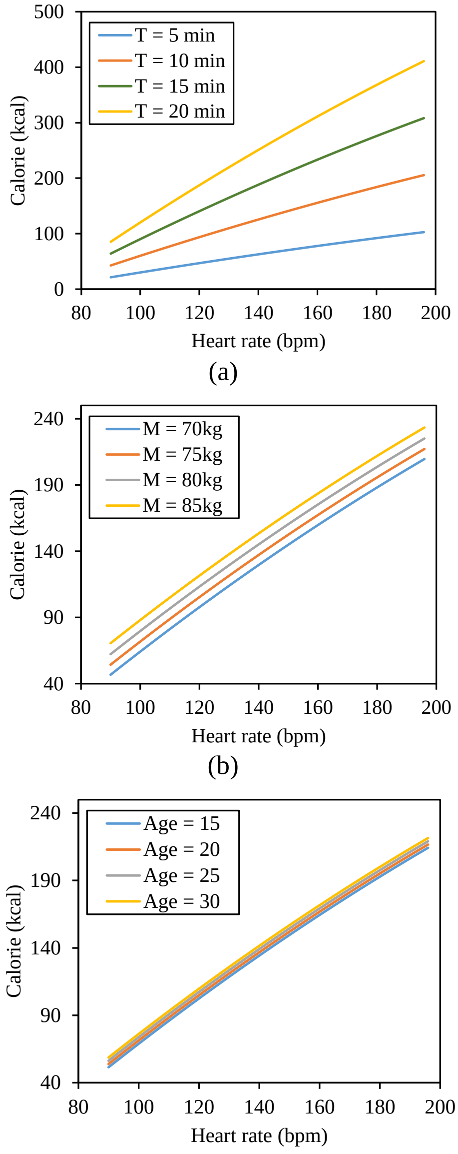


Fig. 9 Predictions of the calorie consumptions by the trained ANN as function of athlete conditions and HR

of gender, heart rate, weight, age and exercise duration time. The output is the calorie consumption.

The ANN requires a set of data achieved from valid sources similar to experimental results or simulations to train the network. Training of a network is adjusting the ANN parameters, i.e., weights and biases, in each node for the purpose of obtaining minimum error between predicted values and actual values provided. This process requires several iterations to achieve minimum possible error. The nature of the ANNs are so that with given data they could reach error values f extremely low value. However, the low errors in training process are not an indication of satisfactory performance of the ANNs (Shariati 2008, Hamidian *et al.* 2011, Shariati *et al.* 2011, 2018, 2019b, 2020e, Shah *et al.* 2015, 2016a, b, Khanouki *et al.* 2016, Toghroli *et al.* 2017, 2018, Chen *et al.* 2019, Li *et al.* 2019, Naghipour *et al.* 2020, Razavian *et al.* 2020, Toghroli *et al.* 2020, Hosseini and Toghroli 2021, Mehrabi *et al.* 2021). This low error value may be a result of overfitting data. The simple meaning of overfitting is that the network could perform satisfactory only with provided data for training and any new set of data could have larger error margin. Therefore, in a process called validation the amount of error for a subset of provided data is evaluated to observe the point in which the training process begins to overfit the data.

For the present study, in total 144 set of physical data of the athletes are provided as validated data to the neural network. 24 of the data were reserved for testing network performance. From remaining data sets, 100 sets used for the purpose of training and 20 set for validation process. The results of these procedure is demonstrated in Fig. 8. Fig. 8(a) shows the training and validation errors with respect to epochs. As observed, in 11000 epochs the error of the calorie consumption predicted by ANN begins to increase indicating overfitting of the network in upcoming epochs.

Therefore, the trained network in 11000 epoch is saved and utilized in further steps.

Fig. 8(b) shows the correlations between predicted values of calorie consumption as predicted by ANN and provided by actual measurements and calculations. The correlation factor for fro training values is $R^2 = 0.854$ and for testing values is $R^2 = 0.832$ which is acceptable in the case of such complicated relations between different values. Therefore, the trained network could be confidently utilized in prediction of calorie consumption during exercises.

In Fig. 9, effects of different parameters on the calorie consumption are presented as function of HR. Fig. 9(a) shows the effect of training time on the calorie burnt in exercise for different values of average heart rate. A nonlinear behavior calorie consumption with respect to HR is seen in all curves with decreasing rate of calorie consumption as HR increases. This result is interesting because linear regression models could not be accurate for this behavior. In constant average heart rate rise in calorie consumption is seen with increase in time duration of exercise. This increase is more intensive in higher HRs. Fig. 9(b) demonstrates the effects of weight of athletes on the calorie burn. It is seen that the effect of increase in mass is not as much as time of exercise. However, with increase in mass there is seen a slight increase in the calorie burn. The behavior of increase is independent from HR since in all values of HR the same amount of increase in calorie consumption is observed. Effect of age is depicted in Fig. 9(c). There is a trivial effect of age observed in this graph. With increase in age from 15 to 30 year, only 3% decrease in calorie consumption is induced keeping all other parameters constant.

4. Conclusions

Measuring energy burn during intensive combat sport has been a challenging concern for a long time. In the present article, the energy consumption during combat sports is measured by use of wearable GoBe2 equipped with nano-technology measuring devices. In this regard, 12 professional combat athletes were asked to wear GoBe2 devices during different sessions of intensive combat exercises. The curves provided by GoBe2 nano-sensor devices are further collected and analyzed for different combat durations. On the other hand, energy consumption in these athlete are calculated using other validated methods to evaluate reliability of GoBe2 wearable devices. Based on the results obtained from these experiments a multi-parameter mathematical model is presented for estimation of combat calorie consumptions. The main results of the present study could be encapsulated as below:

- The provided curves by GoBe2 wearable device show acceptable agreement in following energy consumption with respect to indicating minimum and maximum point quite accurately.
- There is a significant difference between actual match and treadmill exercise measurements.
- ANN could be confidently utilized in prediction of calorie consumption during exercises.
- Total energy expenditure during 10min is overestimated using GoBe2 by approximately 40% higher in comparison to the actual measurements.

Acknowledgement

The study was supported by Shenyang Sport University Key Construction Subjects in 14th five Years Plan (Direction of Sport Health Promotion).

References

Achten, J. and Jeukendrup, A.E. (2003), “Heart rate monitoring”, *Sports Med*., **33**(7), 517-538. https://doi.org/10.2165/00007256-200333070-00004

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

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

Arai, K. (2014). “Rescue system with vital sign, location and attitude sensing together with traffic condition, readiness of helper monitoring in particular for disabled and elderly persons”, *2014 11th International Conference on Information Technology: New Generations*, 7-9, April 2014.

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

Beato, M., Impellizzeri, F.M., Coratella, G. and Schena, F. (2016), “Quantification of energy expenditure of recreational football”, *J. Sports Sci*., **34**(24), 2185-2188. https://doi.org/10.1080/02640414.2016.1167280

Campos, F.A.D., Bertuzzi, R., Dourado, A.C., Santos, V.G.F. and Franchini, E. (2012), “Energy demands in taekwondo athletes during combat simulation”, *Eur. J. Appl. Physiol*., **112**(4), 1221-1228. https://doi.org/10.1007/s00421-011-2071-4

Chen, C., Shi, L., Shariati, M., Toghroli, A., Mohamad, E.T., Bui, D.T. and Khorami, M. (2019), “Behavior of steel storage pallet racking connection-A review”, *Steel Compos. Struct*., **30**(5), 457. https://doi.org/10.12989/scs.2019.30.5.457

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., Tang, H., Wu, S., Habibi, M., Moradi, Z. and Ali, H.E. (2023a), “Nonlinear consecutive dynamic instabilities of thermally shocked composite circular plates on the softening elastic foundation", *Thin Wall. Struct.*, **186**, 110645. https://doi.org/10.1016/j.tws.2023.110645

Dai, Z., Wu, S., Habibi, M. and Ali, H.E. (2023b), "Application of point interpolation mesh-free method for magneto/electro rheological vibrations of sandwich conical panels", *Aerosp. Sci. Technol.*, 108180. https://doi.org/10.1016/j.ast.2023.108180

Dai, Z., Zhang, L., Bolandi, S.Y. and Habibi, M. (2021b), "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

Dong, Y., Gao, Y., Zhu, Q., Moradi, Z. and Safa, M. (2022), "TE-GDQE implementation to investigate the vibration of FG composite conical shells considering a frequency controller solid ring", *Eng. Anal. Bound. Elem.*, **138** 95-107. https://doi.org/10.1016/j.enganabound.2022.01.017

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

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. (2022a), "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

Fan, L., Kong, D., Song, J., Moradi, Z., Safa, M. and Khadimallah, M.A. (2022b), "Optimization dynamic responses of laminated multiphase shell in thermo-electro-mechanical conditions", *Adv. Nano Res.*, **13**(1), 29-45. https://doi.org/10.12989/anr.2022.13.1.029.

Fang, D., Hu, J., Wei, X., Shao, H. and Luo, Y. (2014). "A smart phone healthcare monitoring system for oxygen saturation and heart rate", *2014 International Conference on Cyber-Enabled Distributed Computing and Knowledge Discovery*, 13-15, Oct. 2014.

Fang, Z., Zhu, Z., Wu, P. and Moradi, Z. (2023), "Vibration and damping analysis of sandwich electrorheological fluid deep arches with bi-directional FGM containers", *Eng. Struct.*, **276**, 115325. https://doi.org/10.1016/j.engstruct.2022.115325

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. http://doi.org/10.22076/me.2017.41458.1064

Fu, Z., Yang, B., Shan, M., Li, T., Zhu, Z., Ma, C., Zhang, X., Gou, G., Wang, Z. and Gao, W. (2020), "Hydrogen embrittlement behavior of SUS301L-MT stainless steel laser-arc hybrid welded joint localized zones", *Corros. Sci.*, **164**, 108337.

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

Gilgen-Ammann, R., Roos, L., Wyss, T., Veenstra, B.J., Delves, S.K., Beeler, N., Buller, M.J. and Friedl, K.E. (2021), "Validation of ambulatory monitoring devices to measure energy expenditure and heart rate in a military setting", *Physiol. Measure.*, **42**(8), 085008. https://doi.org/10.1088/1361-6579/ac19f9

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, K., Gou, G., Lv, H. and Shan, M. (2022), "Jointing of CFRP/5083 aluminum alloy by induction brazing: Processing, connecting mechanism, and fatigue performance", *Coatings*, **12**(10), 1559.

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 nano-structure 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. https://doi.org/10.1007/s11665-016-1882-1.

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. Proc.*, **31** 310-323.
\ https://doi.org/10.1016/j.jmapro.2017.11.009

Habibi, M., Mohammadgholiha, M. and Safarpour, H. (2019b), "Wave propagation characteristics of the electrically GNP-reinforced nanocomposite cylindrical shell", *J. Brazil. Soc. Mech. Sci. Eng.*, **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

Hamidian, M., Shariati, M., Arabnejad, M. and Sinaei, H. (2011), "Assessment of high strength and light weight aggregate concrete properties using ultrasonic pulse velocity technique", *Int. J. Phys. Sci.*, **6**(22), 5261-5266. https://doi.org/10.5897/IJPS11.1081

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

Heydari, A. and Shariati, M. (2018), "Buckling analysis of tapered BDFGM nano-beam under variable axial compression resting on elastic medium", *Struct. Eng. Mech.*, **66**(6), 737-748. https://doi.org/10.12989/sem.2018.66.6.737

Hosseini, S.A. and Toghroli, A. (2021), "Effect of mixing Nano-silica and Perlite with pervious concrete for nitrate removal from the contaminated water", *Adv. Concr. Constr.*, **11**(6), 531-544. https://doi.org/10.12989/acc.2021.11.6.531

Hou, F., Wu, S., Moradi, Z. and Shafiei, N. (2021), "The computational modeling for the static analysis of axially functionally graded micro-cylindrical imperfect beam applying the computer simulation", *Eng. Comput.*, 1-19. https://doi.org/10.1007/s00366-021-01456-x

Hu, P., Moradi, Z., Ali, H.E. and Foong, L.K. (2022), "Metaheuristic-reinforced neural network for predicting the compressive strength of concrete", *Smart Struct. Syst.*, **30**(2), 195-207.

Huang, K., Xu, Q., Ying, Q., Gu, B. and Yuan, W. (2023), "Wireless strain sensing using carbon nanotube composite film", *Compos. Part B Eng.*, **256**, 110650. https://doi.org/10.1016/j.compositesb.2023.110650

Huang, X., Hao, H., Oslub, K., Habibi, M. and Tounsi, A. (2021a), "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

Huang, X., Zhang, Y., Moradi, Z. and Shafiei, N. (2022), "Computer simulation via a couple of homotopy perturbation methods and the generalized differential quadrature method for nonlinear vibration of functionally graded non-uniform micro-tube", *Eng. Comput.*, **38**(Suppl 3), 2481-2498. https://doi.org/10.1007/s00366-021-01395-7

Huang, X., Zhu, Y., Vafaei, P., Moradi, Z. and Davoudi, M. (2021b), "An iterative simulation algorithm for large oscillation of the applicable 2D-electrical system on a complex nonlinear substrate", *Eng. Comput.*, 1-13. https://doi.org/10.1007/s00366-021-01320-y

Jahandari, S., Tao, Z., Saberian, M., Shariati, M., Li, J., Abolhasani, M., Kazemi, M., Rahmani, A. and Rashidi, M. (2021), "Geotechnical properties of lime-geogrid improved clayey subgrade under various moisture conditions", *Road Mater. Pave. Des.*, 1-19. 1 https://doi.org/0.1080/14680629.2021.1950816

Jiao, J., Ghoreishi, S.-m., Moradi, Z. and Oslub, K. (2021), "Coupled particle swarm optimization method with genetic algorithm for the static–dynamic performance of the magneto-electro-elastic nanosystem", *Eng. Comput.*, 1-15. https://doi.org/10.1007/s00366-021-01391-x

Jin, X., Moradi, Z. and Rashidi, R. (2023), "Optimal operation of distributed generations in four-wire unbalanced distribution systems considering different models of loads", *Int. Transact. Electr. Energy Syst.*, **2023**. https://doi.org/10.1155/2023/8763116

Khanouki, M.M.A., Ramli Sulong, N.H., Shariati, M. and Tahir, M.M. (2016), "Investigation of through beam connection to concrete filled circular steel tube (CFCST) column", *J. Constr. Steel Res.*, **121**, 144-162. https://doi.org/10.1016/j.jcsr.2016.01.002

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

Kriemler, S., Hebestreit, H. and Bar-Or, O. (2002), "Temperature-related overestimation of energy expenditure, based on heart-rate monitoring in obese boys", *Eur. J. Appl. Physiol.*, **87**(3), 245-250. https://doi.org/10.1007/s00421-002-0629-x

Kreitmair, K.V. (2019), "Dimensions of ethical direct-to-consumer neurotechnologies", *AJOB Neurosci.*, **10**(4), 152-166. https://doi.org/10.1080/21507740.2019.1665120

Li, D.Y., Toghroli, A., Shariati, M., Sajedi, F., Bui, D.T., Kianmehr, P., Mohamad, E.T. and Khorami, M. (2019), "Application of polymer, silica-fume and crushed rubber in the production of Pervious concrete", *Smart Struct. Syst.*, **23**(2), 207-214. https://doi.org/10.12989/sss.2019.23.2.207

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

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, Y., Wang, W., He, T., Moradi, Z. and Larco Benítez, M.A.

(2021c), “On the modelling of the vibration behaviors via discrete singular convolution method for a high-order sector annular system”, *Eng. Comput.*, 1-23. https://doi.org/10.1007/s00366-021-01454-z.

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

Luo, J., Song, J., Moradi, Z., Safa, M. and Khadimallah, M.A. (2022a), “Effect of simultaneous compressive and inertia loads on the bifurcation stability of shear deformable functionally graded annular fabrications reinforced with graphenes”, *Eur. J. Mech. A Solids*, 104581. https://doi.org/10.1016/j.euromechsol.2022.104581

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

Luo, Z.Y., Sinaei, H., Ibrahim, Z., Shariati, M., Jumaat, Z., Wakil, K., Pham, B.T., Mohamad, E.T. and Khorami, M. (2019), “Computational and experimental analysis of beam to column joints reinforced with CFRP plates”, *Steel Compos. Struct.*, **30**(3), 271-280. https://doi.org/10.12989/scs.2019.30.3.271

Ma, L., Liu, X. and Moradi, Z. (2021), “On the chaotic behavior of graphene-reinforced annular systems under harmonic excitation”, *Eng. Comput.*, 1-25. https://doi.org/10.1007/s00366-020-01210-9

Mehrabi, P., Shariati, M., Kabirifar, K., Jarrah, M., Rasekh, H., Trung, N.T., Shariati, A. and Jahandari, S. (2021), “Effect of pumice powder and nano-clay on the strength and permeability of fiber-reinforced pervious concrete incorporating recycled concrete aggregate”, *Constr. Build. Mater.*, **287**, 122652. https://doi.org/10.1016/j.conbuildmat.2021.122652

Michael, M., Meyyazhagan, A., Velayudhannair, K., Pappuswamy, M., Maria, A., Xavier, V., Balasubramanian, B., Baskaran, R., Kamyab, H. and Vasseghian, Y. (2022), “the content of heavy metals in cigarettes and the impact of their leachates on the aquatic ecosystem”, *Sustainability*. **14**(8), 4752. https://doi.org/10.3390/su14084752

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”, *Int. 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

Mohammadhassani, M., Akib, S., Shariati, M., Suhatril, M. and Khanouki, M.M.A. (2014), “An experimental study on the failure modes of high strength concrete beams with particular references to variation of the tensile reinforcement ratio”, *Eng. Fail. Anal.*, **41**, 73-80. https://doi.org/10.1016/j.engfailanal.2013.08.014

Mohammadhassani, M., Suhatril, M., Shariati, M. and Ghanbari, F. (2013), “Ductility and strength assessment of HSC beams with varying of tensile reinforcement ratios”, *Struct. Eng. Mech.*, **48**(6), 833-848. 10.12989/sem.2013.48.6.833

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, Z., Davoudi, M., Ebrahimi, F. and Ehyaei, A.F. (2021), “Intelligent wave dispersion control of an inhomogeneous micro-shell using a proportional-derivative smart controller”, *Wave Random Complex Med.*, 1-24. https://doi.org/10.1080/17455030.2021.1926572

Moradi, Z., Ebrahimi, F. and Davoudi, M. (2022), “Coupled Newmark beta technique and GDQ method for energy harvesting and vibration control of the piezoelectric MEMS/ NEMS subjected to a blast load”, *Eng. Anal. Bound. Elem.*, **144**, 492-506. https://doi.org/10.1016/j.enganabound.2022.08.021

Naghipour, M., Yousofizinsaz, G. and Shariati, M. (2020), “Experimental study on axial compressive behavior of welded built-up CFT stub columns made by cold-formed sections with different welding lines”, *Steel Compos. Struct.*, **34**(3), 347-359. https://doi.org/10.12989/scs.2020.34.3.347

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

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

Peng, S., Habibi, M. and Pourjabari, A. (2023), “Generalized differential quadrature element solution, swarm, and GA optimization technique to obtain the optimum frequency of the laminated rotary nanostructure”, *Eng. Anal. Bound. Elem.*, **151**, 101-114. https://doi.org/10.1016/j.enganabound.2023.02.052

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. Applicat.*, **77**(10), 2608-2626. https://doi.org/10.1016/j.camwa.2018.12.041

RajaPavan, V., Suhas, B.S.S. and Kanni, A. (2017). “Tracking the calorie consumption and location using existing sensors and mobile applications”, *2017 International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC)*, 10-11, Feb 2017.

Razavian, L., Naghipour, M., Shariati, M. and Safa, M. (2020), “Experimental study of the behavior of composite timber columns confined with hollow rectangular steel sections under compression”, *Struct. Eng. Mech.*, **74**(1), 145-156. https://doi.org/10.12989/sem.2020.74.1.145

Rossetto, L.T., Müller, I., Brusamarello, V., Fabris, E. and Pereira, C.E. (2012). “Wireless portable sensor for athletic monitoring”, *2012 IEEE International Instrumentation and Measurement Technology Conference Proceedings*, 13-16, May 2012.

Sabzevari, F., Amelirad, O., Moradi, Z. and Habibi, M. (2023), "Artificial intelligence evaluation of COVID-19 restrictions and speech therapy effects on the autistic children's behavior", *Sci. Rep.*, **13**(1), 4312. https://doi.org/10.1038/s41598-022-25902-y

Safa, M., Maleka, A., Arjomand, M.A., Khorami, M. and Shariati, M. (2019), "Strain rate effects on soil-geosynthetic interaction in fine-grained soil", *Geomech. Eng.*, **19**(6), 523-532. https://doi.org/10.12989/gae.2019.19.6.523

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. https://doi.org/10.1140/epjp/i2018-12385-2

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. https://doi.org/10.1007/s10999-018-9431-8

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

Shah, S.N.R., Sulong, N.H.R., Jumaat, M.Z. and Shariati, M. (2016a), "State-of-the-art review on the design and performance of steel pallet rack connections", *Eng. Fail. Anal.*, **66**, 240-258. https://doi.org/10.1016/j.engfailanal.2016.04.017

Shah, S.N.R., Sulong, N.H.R., Khan, R., Jumaat, M.Z. and Shariati, M. (2016b), "Behavior of industrial steel rack connections", *Mech. Syst. Signal Pr.*, **70-71**, 725-740. https://doi.org/10.1016/j.ymssp.2015.08.026

Shah, S.N.R., Sulong, N.H.R., Shariati, M. and Jumaat, M.Z. (2015), "Steel rack connections: Identification of most influential factors and a comparison of stiffness design methods", *Plos One*, **10**(10), e0139422. https://doi.org/10.1371/journal.pone.0139422

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

Shariat, M., Shariati, M., Madadi, A. and Wakil, K. (2018), "Computational Lagrangian Multiplier Method by using for optimization and sensitivity analysis of rectangular reinforced concrete beams", *Steel Compos. Struct.*, **29**(2), 243-256. https://doi.org/10.12989/scs.2018.29.2.243

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. (2008), *Assessment Building Using None-destructive Test Techniques (Ultra sonic pulse velocity and schmidt rebound hammer)*, Universiti Putra Malaysia.

Shariati, M., Azar, S.M., Arjomand, M.A., Tehrani, H.S., Daei, M. and Safa, M. (2019a), "Comparison of dynamic behavior of shallow foundations based on pile and geosynthetic materials in fine-grained clayey soils", *Geomech. Eng.*, **19**(6), 473. https://doi.org/10.12989/gae.2019.19.6.473

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., 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. https://doi.org/10.12989/scs.2020.34.3.393

Shariati, M., Heyrati, A., Zandi, Y., Laka, H., Toghroli, A., Kianmehr, P., Safa, M., Salih, M.N.A. and Poi-Ngian, S. (2019b), "Application of waste tire rubber aggregate in porous concrete", *Smart Struct. Syst.*, **24**(4), 553-566. https://doi.org/10.12989/sss.2019.24.4.553

Shariati, M., Kamyab, H., Habibi, M., Ahmadi, S., Naghipour, M., Gorjinezhad, F., Mohammadirad, S. and Aminian, A. (2023), "Sulfuric acid resistance of concrete containing coal waste as a partial substitute for fine and coarse aggregates", *Fuel*, **348**, 128311. https://doi.org/10.1016/j.fuel.2023.128311

Shariati, M., Ramli Sulong, N.H., Sinaei, H., Arabnejad Khanouki, M.M. and Shafigh, P. (2011), "Behavior of channel shear connectors in normal and light weight aggregate concrete (experimental and analytical study)", *Adv. Mater. Res.*, **168**, 2303-2307. https://doi.org/10.4028/www.scientific.net/AMR.168-170.2303

Shariati, M., Shariati, A., Trung, N.T., Shoaei, P., Ameri, F., Bahrami, N. and Zamanabadi, S.N. (2020f), "Alkali-activated slag (AAS) paste: Correlation between durability and microstructural characteristics", *Constr. Build. Mater.*, 120886. https://doi.org/10.1016/j.conbuildmat.2020.120886

Shariati, M., Tahir, M.M., Wee, T.C., Shah, S.N.R., Jalali, A., Abdullahi, M.M. and Khorami, M. (2018), "Experimental investigations on monotonic and cyclic behavior of steel pallet rack connections", *Eng. Fail. Anal.*, **85**, 149-166. https://doi.org/10.1016/j.engfailanal.2017.08.014

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

Silva, H.S.d., Nakamura, F.Y., Papoti, M., Da Silva, A.S. and Dos-Santos, J.W. (2021), "Relationship between heart rate, oxygen consumption, and energy expenditure in futsal", *Front. Psychol.*, **12**, 698622. https://doi.org/10.3389/fpsyg.2021.698622

Slimani, M., Znazen, H., Sellami, M. and Davis, P. (2018), "Heart rate monitoring during combat sports matches: A brief review", *Int. J. Perform. Anal. Sport*, **18**(2), 273-292. https://doi.org/10.1080/24748668.2018.1469080

Suhatril, M., Osman, N., Azura Sari, P., Shariati, M. and Marto, A. (2019), "Significance of surface eco-protection techniques for cohesive soils slope in Selangor, Malaysia", *Geotech. Geol. Eng.*, **37**(3), 2007-2014. https://doi.org/10.1007/s10706-018-0740-3

Tao, X., Liao, Z., Zhang, Y., Fu, F., Hao, M., Song, Y. and Song, E. (2021), "Aptamer-quantum dots and teicoplanin-gold nano-particles constructed FRET sensor for sensitive detection of Staphylococcus aureus", *Chinese Chem. Lett.*, **32**(2), 791-795.

Toghroli, A., Mehrabi, P., Shariati, M., Trung, N.T., Jahandari, S.

and Rasekh, H. (2020), “Evaluating the use of recycled concrete aggregate and pozzolanic additives in fiber-reinforced pervious concrete with industrial and recycled fibers”, *Constr. Build. Mater.*, **252**, 118997. https://doi.org/10.1016/j.conbuildmat.2020.118997

Toghroli, A., Shariati, M., Karim, M.R. and Ibrahim, Z. (2017). “Investigation on composite polymer and silica fume–rubber aggregate pervious concrete”, *Fifth International Conference on Advances in Civil, Structural and Mechanical Engineering - CSM 2017*, Zurich, Switzerland, September, 2017.

Toghroli, A., Shariati, M., Sajedi, F., Ibrahim, Z., Koting, S., Mohamad, E.T. and Khorami, M. (2018), “A review on pavement porous concrete using recycled waste materials”, *Smart Struct. Syst.*, **22**(4), 433-440. https://doi.org/10.12989/sss.2018.22.4.433

Wallén, M.B., Hasson, D., Theorell, T., Canlon, B. and Osika, W. (2012), “Possibilities and limitations of the polar RS800 in measuring heart rate variability at rest”, *Eur. J. Appl. Physiol.*, **112**(3), 1153-1165. https://doi.org/10.1007/s00421-011-2079-9

Wang, P., Gao, Z., Pan, F., Moradi, Z., Mahmoudi, T. and Khadimallah, M.A. (2022a), “A couple of GDQM and iteration techniques for the linear and nonlinear buckling of bi-directional functionally graded nanotubes based on the nonlocal strain gradient theory and high-order beam theory”, *Eng. Anal. Bound. Elem.*, **143**, 124-136. https://doi.org/10.1016/j.enganabound.2022.06.007

Wang, X., Wu, S., Yin, J., Moradi, Z., Safa, M. and Khadimallah, M.A. (2023), “On the electromechanical energy absorption of the reinforced composites piezoelectric MEMS via Adaptive neuro-fuzzy inference system and MCS theory”, *Compos. Struct.*, **303**, 116246. https://doi.org/10.1016/j.compstruct.2022.116246

Wang, Y., Yang, J., Moradi, Z., Safa, M. and Khadimallah, M.A. (2022b), “Nonlinear dynamic analysis of thermally deformed beams subjected to uniform loading resting on nonlinear viscoelastic foundation”, *Eur. J. Mech. A Solids*, **95**, 104638. https://doi.org/10.1016/j.euromechsol.2022.104638

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

Wolbring, G. and Leopatra, V. (2013), “Sensors: Views of staff of a disability service organization”, *J. Personal. Med.*, **3**(1), 23-39. https://doi.org/10.3390/jpm3010023

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

Xiang, J., Lai, Y., Moradi, Z. and Khorami, M. (2023), “Wave propagation phenomenon of functionally graded graphene oxide powder-strengthened nanocomposite curved beam”, *Solid State Commun.*, 115193. https://doi.org/10.1016/j.ssc.2023.115193

Xie, Q., Sinaei, H., Shariati, M., Khorami, M., Mohamad, E.T. and Bui, D.T. (2019), “An experimental study on the effect of CFRP on behavior of reinforce concrete beam column connections”, *Steel Compos. Struct.*, **30**(5), 433-441. https://doi.org/10.12989/scs.2019.30.5.433

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. https://doi.org/10.1007/s12598-020-01385-6.

Xu, Q.Y., Tan, Z., Liao, X.-W. and Wang, C. (2022), “Recent advances in nanoscale metal-organic frameworks biosensors for detection of biomarkers”, *Chinese Chem. Lett.*, **33**(1), 22-32. https://doi.org/10.1016/j.cclet.2021.06.015.

Xu, W., Pan, G., Moradi, Z. and Shafiei, N. (2021), “Nonlinear forced vibration analysis of functionally graded non-uniform cylindrical microbeams applying the semi-analytical solution”, *Compos. Struct.*, **275**, 114395. https://doi.org/10.1016/j.compstruct.2021.114395

Yang, C., Su, C., Hu, H., Habibi, M., Safarpour, H. and Khadimallah, M.A. (2023), “Performance optimization of photovoltaic and solar cells via a hybrid and efficient chimp algorithm”, *Solar Energy*, **253**, 343-359. https://doi.org/10.1016/j.solener.2023.02.036

Yang, N., Moradi, Z., Arvin, H., Muhsen, S. and Khadimallah, M.A. (2022a), “A study on small scale thermal dynamic instability of rotating GPL-reinforced microbeams under principal parametric resonance stimulation of axial and transversal modes regarding the proportional damping”, *Thin Wall. Struct.*, **180**, 109806. https://doi.org/10.1016/j.tws.2022.109806

Yang, N., Moradi, Z., Khadimallah, M.A. and Arvin, H. (2022b), “Application of the Chebyshev–Ritz route in determination of the dynamic instability region boundary for rotating nano-composite beams reinforced with graphene platelet subjected to a temperature increment”, *Eng. Anal. Bound. Elem.*, **139** 169-179. https://doi.org/10.1016/j.enganabound.2022.03.013

Yu, X., Maalla, A. and Moradi, Z. (2022), “Electroelastic high-order computational continuum strategy for critical voltage and frequency of piezoelectric NEMS via modified multi-physical couple stress theory”, *Mech. Syst. Signal Pr.*, **165**, 108373. https://doi.org/10.1016/j.ymssp.2021.108373

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, P., Gao, Y., Moradi, Z., Ali, Y.A. and Khadimallah, M.A. (2022), “A semi-analytical procedure for cross section effect on the buckling and dynamic stability of composite imperfect truncated conical microbeam”, *Steel Compos. Struct.*, **44**(3), 357-374. https://doi.org/10.12989/scs.2022.44.3.371

Zhang, S., Lai, Y., Chen, K., Habibi, M., Khorami, M. and Haider Mussa, Z. (2023), “Influence of MWCNT’s waviness and aggregation factors on wave dispersion response of MWCNT-strengthened nanocomposite curved beam”, *Structures*, **53**, 1239-1249. https://doi.org/10.1016/j.istruc.2023.04.024

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

Zhao, H., Li, C., Fu, Y., Oyarhossein, M.A., Habibi, M. and Safarpour, H. (2023), “Quasi-static indentation, low-velocity impact, and resonance responses of the laminated double-curved panel considering various boundary conditions”, *Thin Wall. Struct.*, **183**, 110360. https://doi.org/10.1016/j.tws.2022.110360

Zhao, Y., Moradi, Z., Davoudi, M. and Zhuang, J. (2021), “Bending and stress responses of the hybrid axisymmetric system via state-space method and 3D-elasticity theory”, *Eng. Comput.*, 1-23. https://doi.org/10.1007/s00366-020-01242-1

Zheng, W., Liu, J., Oyarhossein, M.A., Safarpour, H. and Habibi, M. (2023), “Prediction of nth-order derivatives for vibration responses of a sandwich shell composed of a magneto-rheological core and composite face layers”, *Eng. Anal. Bound. Elem.*, **146** 170-183. https://doi.org/10.1016/j.enganabound.2022.10.019

Zheng, Y., Jin, H., Jiang, C., Moradi, Z., Khadimallah, M.A. and Moayedi, H. (2022), “Analyzing behavior of circular concrete-filled steel tube column using improved fuzzy models”, *Steel*

Compos. *Struct*., **43**(5), 625-637. https://doi.org/10.12989/scs.2022.43.5.625
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, J., Moradi, Z., Safa, M. and Khadimallah, M.A. (2022a), "Intelligent modeling to investigate the stability of a two-dimensional functionally graded porosity-dependent nanobeam", *Comput*. *Concr*., **30**(2), 85-97. https://doi.org/10.12989/cac.2022.30.2.085
Zhou, L., Moradi, Z., Al-Tamimi, H.M. and Ali, H.E. (2022b), "On propagation of elastic waves in an embedded sigmoid functionally graded curved beam", *Steel Compos*. *Struct*., **44**(1), 17. https://doi.org/10.12989/scs.2022.44.1.017
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., Chen, J., Gou, G., Chen, H. and Li, P. (2017), "Ameliorated longitudinal critically refracted—Attenuation velocity method for welding residual stress measurement", *J*. *Mater*. *Proc*. *Technol*., **246**, 267-275. https://doi.org/10.1016/j.jmatprotec.2017.03.022.

JL