Advances in Aircraft and Spacecraft Science, *Vol. 10, No. 5 (2023) 393-418*
https://doi.org/10.12989/aas.2023.10.5.393

Aircraft delivery vehicle with fuzzy time window for improving search algorithm

C.C. Hung[1], T. Nguyễn[2] and C.Y. Hsieh*[3]

[1]*Faculty of National Hsin Hua Senior High School, Tainan, Taiwan*
[2]*Ha Tinh University, Dai Nai Ward, Ha Tinh City, Vietnam*
[3]*National Pingtung University Education School, No.4-18, Minsheng Rd., Pingtung City, Pingtung County 900391, Taiwan*

(Received June 5, 2023, Revised October 9, 2023, Accepted November 13, 2023)

Abstract. Drones are increasingly used in logistics delivery due to their low cost, high-speed and straight-line flight. Considering the small cargo capacity, limited endurance and other factors, this paper optimized the pickup and delivery vehicle routing problem with time windows in the mode of "truck+drone". A mixed integer programming model with the objective of minimizing transportation cost was proposed and an improved adaptive large neighborhood search algorithm is designed to solve the problem. In this algorithm, the performance of the algorithm is improved by designing various efficient destroy operators and repair operators based on the characteristics of the model and introducing a simulated annealing strategy to avoid falling into local optimum solutions. The effectiveness of the model and the algorithm is verified through the numerical experiments, and the impact of the "truck+drone" on the route cost is analyzed, the result of this study provides a decision basis for the route planning of "truck+drone" mode delivery.

Keywords: adaptive large neighborhood search algorithm; pick-up and delivery problem with time window; vehicle routing

1. Introduction

With the rapid development of e-commerce, the demand for logistics continues to rise, and many logistics companies begin to pay attention to the efficiency and economy of distribution (Chen 2008, Chen 2007, Hsieh 2005, Chen 2010, Zhao *et al.* 2023). Due to the advantages of low cost, fast speed, and straight-line driving, drones have attracted the attention of many companies in the last mile delivery. Many companies such as Amazon, Google, and DHL have carried out practical experiments, and are gradually building unmanned aerial vehicles. Man-machine distribution system (Alimoradzadeh *et al.* 2023, Jafari *et al.* 2023, Khosravikhor *et al.* 2023, Al-Jaafari *et al.* 2023, Shih 2012, Shih 2023). However, drones have the disadvantages of small cargo capacity, short cruising range, and susceptibility to interference, so they cannot meet the needs of modern logistics when used alone. Using the joint distribution of trucks and UAVs, taking advantage of the advantages of UAVs, reducing the number of distribution trucks, can reduce transportation costs and improve distribution efficiency (Lee 2012, Lee 2023, Lin 2009, Lin 2013,

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

http://www.techno-press.org/?journal=aas&subpage=7 ISSN: 2287-528X (Print), 2287-5271 (Online)

Liu 2013, Liu 2023, Akbari *et al.* 2023, Aksoylu *et al.* 2023).

It is an excellent semi-active damping device and can be widely used in transportation and other fields, such as automobile suspension systems. And it is beneficial to improve the comfort and running quality of the vehicle (Chandrasekaran *et al.* 2023, Chen *et al.* 2023, Hsu 2013, Kuan 2012, Chen 2013, Cheng 2023). As a critical device in vibration damping systems, the engineering design of an MR damper directly impacts its performance index, and a reasonable simulation can get the best design scheme in the shortest time with the least manpower and material resources (Liu *et al.* 2022). Wang built a vehicle routing problem model for UAVs, and verified that the delivery time of the joint delivery of trucks and UAVs is less than that of trucks alone even in the worst case (Chiou 2023, Fard *et al.* 2023, Gholizadeh *et al.* 2023, Ayough *et al.* 2023, Bai *et al.* 2023, Kuo 2010). Scramento *et al.* for VRP-D An adaptive large neighborhood search algorithm is proposed to solve the model. Meng Shanshan *et al.* considered the multi-truck-UAV mixed delivery problem where the UAV can carry multiple packages at a time, and proposed a two-stage collaborative optimization algorithm to minimize the cost (Abad *et al.* 2023, Zou 2023, Banh *et al.* 2023, Behshad *et al.* 2023, Biao *et al.* 2023, Bounouara *et al.* 2023).

and delivery vehicle routing problem with time window (Pickup and Delivery Problem with Time Windows, PDPTW) not only has a wide range of applications in logistics distribution, but also has been a hot spot in academic research, Baldacci *et al.* solve it by combining multiple exact algorithms such as integer programming, dual theory and column generation (Hsiao 2005, Tsai 2008, Tsai 2023, Yeh 2013, Zaoui *et al.* 2023, Zhan *et al.* 2023). Bent uses a two-stage algorithm to solve PDPTW, the first stage uses a simulated annealing algorithm to reduce the number of vehicles, and the second stage uses a large neighborhood search algorithm to minimize the path cost. Ropke proposed to solve PDPTW based on the large neighborhood search algorithm Adaptive Large Neighborhood Search Algorithm (Adaptive Large Neighborhood Search, ALNS), the results show that ALNS has a good effect on solving large-scale problems. Goeke proposed an improved tabu search algorithm to solve the electric vehicle pick-up and delivery problem with a time window. Leng Longlong *et al.* established a low-carbon location-routing problem model for simultaneous pickup and delivery with the goal of carbon emissions, and used the quantum hyperheuristic algorithm to solve the model. Ren Teng *et al.* analyzed the transportation department's service for e-commerce orders while picking up and delivering intra-city orders, and constructed a path optimization that minimizes the total expenditure of individual customers, e-commerce enterprise customers and the transportation department. Mathematical model, and design an improved genetic algorithm to solve it (Cánovas-González *et al.* 2023, Hong *et al.* 2023, Chen 2014, Chiang 2010, 2011, Zhang *et al.* 2023, Chen 2009).

In the previous literature, there has been no research on PDPTW under the "truck+drone" mode. As the commercial value of drones continues to be tapped, the demand for intra-city delivery, "fresh food home" and takeaways, etc. Continuously rising, considering the model of truck+UAV, optimizing PDPTW can enrich the logistics distribution model and expand the business scenario of UAV. Therefore, this article focuses on the pickup and delivery with time window under the "truck+UAV" mode Vehicle routing problem (Pickup and Delivery Problem with Time Windows and Drone, PDPTW-D) was studied, and a PDPTW-D mixed integer programming model was established to minimize the number of vehicles and routing costs, the ALNS algorithm was proposed to solve the problem. In this algorithm, a variety of efficient damage operators and repair operators based on the characteristics of the model are proposed, and simulated annealing acceptance criteria are introduced to avoid falling into local optimal solutions to improve the performance of the algorithm. The effectiveness of the algorithm is verified by testing examples of different scales, and the results show that the joint transportation mode of trucks and UAVs can save a lot of route costs.

2. System description

The research problem of this paper can be described as: there is only one distribution center in the logistics network, and the distribution center has an unlimited number of trucks of the same type and drone. The truck departs from the distribution center, and each truck carries a drone. The vehicle load must not exceed its maximum capacity. The truck first picks up the goods at the pick-up point, and then the truck or drone delivers the goods to the corresponding delivery point. During the delivery process, both the truck and the drone keep moving at a constant speed. The drone starts from the truck, and can only deliver to the delivery point where the cargo capacity and battery life meet the constraints, and then merge with the truck. When the drone is delivering, the truck goes to the next customer point to complete the pick-up and delivery needs. The battery will be replaced immediately after the drone meets the truck to ensure the endurance of the next drone flight. Each customer point can only be visited once by a truck or drone. Vehicle access must meet the requirements of the customer time window. If it arrives earlier than the start time of the customer time window, it needs to wait, and if it arrives later than the end time of the time window, it cannot visit.

Symbols and parameters

P={1, 2,..., n } collection of pick-up points

D={ n+1,..., 2 n } set of delivery points

K={1, 2,..., k } set of trucks

M: infinite number

Q: The maximum cargo capacity of the truck

e: the maximum battery life of the drone d_{ij}: the driving distance of the vehicle from i to j *c:* the distance cost coefficient of the drone delivery e_i, l_i: time window range of client i

L: The time it takes to launch the drone

R: the time it takes to recover the drone

wxya _: 0-1 variable, 1 when truck passes arc (i, j)

y_{ijk}: 0-1 variable, 1 when drone passes arc (i, j)

s_j: the truck is at customer j service hours

t_{ik}: truck arrives at customer point i time

td_{ik}: the time when the drone arrives at customer point i

When 0 is the starting point, 2 n+1 is the end point, D' is the set of customer points that the drone can visit in the delivery point, and P' is the set of corresponding pick-up points. where $N=P \cup D$, $V=N \cup \{0, 2n+1\}$, D' D, P' P.

PDPTW-D Model

The constructed PDPTW-D model is as follows

$$(\sum_{k\in K}\sum_{j\in P} x_{0jk}, \sum_{k\in K}\sum_{i\in V}\sum_{j\in V} x_{ijk}\, d_{ij} + \sum_{k\in K}\sum_{i\in V}\sum_{j\in V} c\, d_{ij} y_{ijk}) \quad (1)$$

min

$$\sum_{k\in K}\sum_{j\in N} x_{ijk} = 1, \forall i \in P \quad (2)$$

$$\text{st} \sum_{j\in N} x_{ijk} = \sum_{j\in N} x_{j,n+i,k}, \forall i \in P\backslash P', \forall k \in K \quad (3)$$

$$\sum_{j\in N} x_{ijk} - \sum_{j\in N} x_{j,n+i,k} - \sum_{j\in N} y_{j,n+i,k}, \forall k \in K, \forall i \in P' \quad (4)$$

$$\sum_{j\in p} x_{0jk} = 1, \forall k \in K \quad (5)$$

$$\sum_{i\in D} x_{i,2n+1,k} = 1, \forall k \in K \quad (6)$$

$$x_{0,2n+1,k} = 0, \forall k \in K \quad (7)$$

$$\sum_{i\in V} x_{iik} = 0, \forall k \in K \quad (8)$$

$$\sum_{i\in V} y_{iik} = 0, \forall j \in N, \forall k \in K \quad (9)$$

$$\sum_{i\in V\backslash(2n+1)} x_{ijk} - \sum_{m\in V\backslash\{0\}} x_{jmk} = 0, \forall j \in N, \forall k \in K \quad (10)$$

$$\sum_{j\in N} y_{ijk} \le 1, \forall k \in K, \forall i \in N, \quad (11)$$

$$\sum_{j\in N} y_{jik} \le 1, \forall k \in K, \forall i \in N \quad (12)$$

$$\sum_{i\in N} y_{ijk} = \sum_{i\in N} y_{jik}, \forall k \in K, \forall j \in D' \quad (13)$$

$$y_{ijk} + y_{jmk} \le x_{imk} + 1, \forall k \in K, \forall i \in N, \forall j \in D, \forall m \in N \quad (14)$$

$$t_{ik} \le t_{n+i,k}, \forall k \in K, \forall i \in P \quad (15)$$

$$t_{ik} \le td_{n+i,k}, \forall k \in K, \forall i \in P' \quad (16)$$

$$td_{ik} \ge t_{ik} - M(1 - \sum_{i\in D'} y_{ijk}), \forall k \in K, \forall i \in N \quad (17)$$

$$td_{ik} \le t_{ik} + M(1 - \sum_{j\in D'} y_{ijk}), \forall k \in K, \forall i \in N \quad (18)$$

$$td_{mk} \ge t_{mk} - M(1 - \sum_{j\in D'} y_{jmk}), \forall k \in K, \forall m \in N \quad (19)$$

$$td_{mk} \le t_{mk} + M(1 - \sum_{j\in D'} y_{jmk}), \forall k \in K, \forall m \in N \quad (20)$$

$$L\, y_{ijk} + R y_{jmk} + t_{ik} + t_{im}^{T} + S_i \le t_{mk} + M(1 - x_{imk}), \forall k \in K, \forall j \in D', \forall i \in N, \forall m \in N \quad (21)$$

$$td_{jk} \ge td_{ik} + cd_{ij} + L - M(1 - y_{ijk}), \forall k \in K, \forall j \in D', \forall i \in N, \forall m \in N td_{jk} + cd_{jm} + S_J + R - M(1 - y_{jmk}) \le td_{mk}, \forall k \in K, \forall j \in D', \forall m \in N e_i \le t_{ik} \le l_i, \forall k \in K, \forall i \in V e_i \le td_{ik} \le l_i, \forall k \in K, \forall i \in D' \quad (25)$$

$$\sum_{j\in N}(\sum_{m\in V/\{0\}} p_j x_{jmk} + \sum_{m\in V/\{0\}} p_j y_{jmk}) \le Q, \forall k \in K \quad (26)$$

$$td_{mk} - td_{ik} \le e + M(2 - y_{ijk} - y_{jmk}), \forall k \in K, \forall i \in N, \forall j \in D' \quad (27)$$

The objective function (1) is to minimize the path cost, that is, to minimize the truck path cost and the UAV path cost. Constraint (2) means that each pick-up point is access. Constraint (3) means that for delivery points whose demand can only be satisfied by trucks, when the pick-up point is visited, the delivery point is visited by trucks. Constraint (4) means that for a delivery point whose demand is satisfied by drone delivery, when the pick-up point is visited, the delivery point is visited by a truck or a drone. Constraint (5) states that each truck must leave the distribution center. Constraint (6) states that each truck must return to the distribution center. Constraint (7) states that trucks are not accepted for transport only between distribution centers. Constraints (8)-(9) are removed from loops. Constraint (10) ensures path continuity. Constraints (11)-(12) state that each truck carries only one drone. Constraint (13) states that the UAV only visits one delivery point at a time. Constraint (14) states that no new drones take off during drone deliveries. Constraints (15)-(16) indicate that the pick-up point must be visited first, and then the delivery point must be visited. Constraints (17)-(20) are time synchronization constraints for trucks and UAVs. Constraints (21) and define the time constraints for trucks to arrive at customer points. Constraints (22)-(23) define the time constraints for the UAV to reach the customer point. Constraints (24)-(25) represent time window constraints. Constraints (26) represent load constraints. Constraint (27) is the power constraint of the UAV.

3. Algorithm design of adaptive large neighborhood search

The pick-up and delivery vehicle routing problem with a time window in the "truck+drone" mode is an extension of the PDPTW problem, which is an NP- hard problem, and it is difficult to solve the problem in an acceptable time with precise algorithms and optimization solvers such as CPLEX large-scale examples. The ALNS algorithm can solve large-scale instances in a short period of time, so the article uses the ALNS algorithm to solve.

The ALNS algorithm is an adaptive large-neighborhood search algorithm that uses damage operators and repair operators to search the solution space. It was first proposed by Ropke on the basis of the large-neighborhood search algorithm. Delivery vehicle routing problem. In the search process, the algorithm adaptively selects the search operator according to the improvement of the operator to the solution, and the operator with a better improvement to the solution has a greater probability of being selected again to search for the solution in subsequent iterations, so as to achieve the optimal solution. The efficient search of the solution space improves the performance of the algorithm. In addition, in order to jump out of the local optimal solution, the algorithm also uses the new solution acceptance criterion of simulated annealing.

The algorithm framework of PDPTW-D is shown in Fig. 1: firstly, the greedy algorithm is used to construct the truck route, secondly, the ALNS is used to minimize the number of vehicles, thirdly, according to the UAV capacity constraints, time windows and other constraints, the delivery node is changed from truck access to UAV visits to save the path cost, finally, based on the fixed number of vehicles, the ALNS algorithm is applied to minimize the path cost. The repair operator used in the ALNS algorithm that minimizes the number of vehicles refers to the operator in the article of Ropke, which is optimized only for pure truck paths, the truck priority used in the ALNS algorithm that minimizes the path cost. The greedy repair operator and the truck-first regret value are inserted into the repair operator, which needs to consider the UAV path.

The article ALNS is shown in Algorithm 1. First, according to the operator weight, the roulette method is used to select the destruction operator and the repair operator to destroy and repair the current solution, and then apply the simulated annealing criterion to judge whether to accept the new solution. Finally, according to the iterative. In the process, each operator updates its weight on the improvement of the solution until the stopping criterion is satisfied. Each iteration the current temperature T drops to $T \quad a$, a is the cooling rate of simulated annealing temperature, and the stopping criterion of the algorithm is the unimproved times of the current solution, the maximum total number of iterations and the longest running time of the algorithm.

Algorithm 1: ALNS Algorithm Framework

Inputs: initial temperature $T_{init,}$ current truck route S, cooling rate a,

Let $S_{best=}S$, $T=T_{init,}$

destruction operatorσ^- ={1,..., 1}, repair operatorσ^+ ={1,..., 1},

do
Use the roulette method to select the damage operator *d according to the operator weight*, select the repair operator *r* according to the operator weight by the roulette method, $S'=r\ (d\ (S))$,
if $f\ (S') < f\ (S_{best})$ **then**
$S_{best}=S'$, update the operator weights in - and +,
end if
$T=T \quad a$,
while the stopping criterion is reached
return S_{best}
destruction operator

According to the characteristics of PDPTW-D problem, the requirements of correlation destroying operator and random destroying operator are put forward. Both operators destroy q requirements, q is 1 and $q_{\max}$ Random value between. When the pick-up point of a demand is destroyed, the corresponding delivery point is also destroyed.

(1) Correlation Destroyer

The correlation destroying operator was proposed by Shaw, which refers to destroying the current solution by destroying similar client nodes in the path. In the article, first randomly destroy a requirement, and then continuously destroy q-1 requirements with the highest similarity to this requirement. The similarity $R\ (i, j)$ between requirements i and j in the article is determined by three aspects: distance, time and load, and its calculation formula is as follows:

$$R(i,j) \qquad (d_{A(i),A(j)} \quad d_{B(i),B(j)})$$
$$(|T_{A(i)} \quad T_{A(j)}| \qquad |T_{B(i)} \quad T_{B(j)}|)$$
$$|l_i \quad l_j|,$$

Among them, A (i) and B (i) represent the pick-up point and delivery point of demand i, A (j) and B (j) represent the pick-up point and delivery point of demand j, d A (i), A (j) and d B (i), B (j) are the distances between the pick-up point and the delivery point of demand i and j respectively, and T A (i) and T B (i) are respectively T A (j) and T B (j) are the time to reach the pick- up point and delivery point of demand j respectively. The smaller R (i, j), the higher the similarity between requirement i and requirement j. If the take-off point or landing point of a delivery point delivered by a drone is destroyed, the delivery point and pick-up point of its corresponding demand will be destroyed. Correlation destruction operator is shown in Algorithm 2:

Algorithm 2: Correlation Destruction Operator
Input: the current route S, the demand quantity q that is planned to be destroyed,
Randomly select demand r from S and put it into array D, D={ r },
while |D|<q
from array D Randomly select a demand r from among them,
Store the remaining demand in S in the array L in,
Arrange the array L according to the formula, i<j means R (r, L|i|) <R (r, L|j|),
Randomly choose a number y from 0,1, D=D ∪{ L (y p |L|]},
end while
Destroy all requirements in D,
if the takeoff point or landing point of the drone is destroyed then
The drone's access point and its corresponding pickup point were also compromised,
end if
return Route S composed of unbroken requirements

random damage operator
q requirements from the path. If the take-off point or landing point of the drone is destroyed in the original route, the corresponding pick-up point or delivery point should also be destroyed. The random destructor runs faster than the correlation destructor. Although poorer solutions may appear, it helps to search for diversity and jump out of local optimal solutions.
repair operator

The truck-priority greedy repair operator and the truck-priority regret value insertion repair operator used in this article are introduced in detail as follows: (1) Truck-first greedy repair operator

The truck-first greedy repair operator is divided into two steps: first insert all destroyed demand points into paths visited by trucks, and then change the delivery points accessible by drones from trucks to drones. Define Δf ik is the change amount of the objective function after inserting the pick-up point i and the corresponding delivery point in the path k. In the process of constructing the route visited by trucks, the location of pick-up point i and its corresponding delivery point is given by minc i Decide. where c i=min k∈K {Δf ik}. The process of this operator is shown in Algorithm 3. In the process of changing the delivery nodes visited by trucks to UAVs, first construct the set C of all delivery points that UAVs can visit in the current solution. Then randomly select a node c in C, if cerator with truck priority and its pick-up point *c'* are only related to the truck, then judge whether it is possible to use drone delivery according to the path cost, and find the best location of these two customer nodes. Continue this method until all client nodes in set *C* are traversed. Retrieve the sort that yields the greatest savings, that is, the current solver
case.

Algorithm 3: Truck-first greedy repair operator

Input: current route *S*, collection of uninserted pick-up points *D*,
while $D \neq 0$ **do**
Randomly select a pick-up point *i* in *D*, $D = D \setminus \{ i \}$,
According to $minc_{i}$, $c_{i} = min_{k \in K} \{\Delta f_{ik}\}$ insert the pick-up point *i* and its corresponding delivery point,
end while return *S*
C=all delivery points satisfying the drone capacity,
while $C \neq 0$ **do**
Randomly select a point in *C*, $C = C \setminus \{ c \}$,
if point *c* and its corresponding pick-up point *c'* are only related to the truck, that is, not the take-off point, landing point and access point of the drone **then**
$S' = S$, $S = S \setminus \{ c, c' \}$, $f(S1) = INF$,
for each path in *S* **do**
if current route capacity+$q_{c} + q_{c'} < Q$ **then**
All adjacent two node positions on **the for path do**
Construct the path $V = < i, c', i+1 >$ for the truck to visit *c'*, the path $P = < m, c, m+1 >$ for the drone to visit *c*, and the node position of point *m is* after point *c'*,
if (*c* and *c'* satisfy the time window constraint in the path) && (UAV flight meets the endurance requirement) **then if** the newly constructed path cost $f(S2) < f(S1)$ **then**
$S1 = S2$,
end if end if
end for end if
end for return *S* 1,

if *f* (*S* 1)< *f* (*S′*) **then**
S=*S* 1,
else
S=*S′*,
end if end while return *S* *best*

(2) The regret value of truck priority is inserted into the repair operator

The implementation of this operator is divided into two steps. The first step is to insert all the destroyed pick-up points and delivery points in the way of truck delivery.

The fuzzy law can be derived as follows.

$$0 > \dot{V}(x) - \gamma_{50l}^2 \omega^T \omega + z^T z$$
$$= \dot{x}^T \nabla_x(x) - \gamma_{50}^2 f \omega^T \omega + z^T z$$
$$= \frac{1}{g-1} \dot{x}^T \nabla_{xx} V(x) x - \gamma_{50}^2 f \omega^T \omega + z^T z$$
$$= g\dot{x}^T\, P(x)x - \gamma_{50}^2 f \omega^T \omega + z^T z$$
$$= \frac{g}{2}\left(x^T \bar{A}_{\mu\mu\mu}^T(x,y)P(x)x + \omega^T B_{\infty\mu}^T(x)P(x)x + *\right) + \bar{C}_{\mu\mu\mu}^d(x,y)\bar{C}_{\mu\mu\mu}(x,y)$$
$$= \begin{bmatrix} x \\ \omega \end{bmatrix}^T \begin{bmatrix} \bar{A}_{\mu\mu\mu}^T(x,y)\frac{g}{2}P(x) + \frac{g}{2}P(x)\bar{A}_{\mu\mu\mu}(x,y) + \bar{C}_{\mu\mu\mu}^d(x,y)\bar{C}_{\mu\mu\mu}(x,y) \\ D_{\infty\mu}^T(x)C_{\mu\mu\mu}(x,y) + B_{\infty\mu}^T(x)\frac{g}{2}P(x) \\ C_{\mu\mu\mu}^T(x)D_{\infty\mu}(x) + \frac{g}{2}P(x)B_{\infty\mu}(x) \\ D_{\infty\mu}^T(x)D_{\infty\mu}(x) + \gamma_{50l}^2 I \end{bmatrix} \begin{bmatrix} x \\ \omega \end{bmatrix}$$

where

$$\Psi_u = \begin{bmatrix} \begin{pmatrix} -A_s(x)G - G^T A_s^T(x) \\ -B_s(x)Z_s(x) - Z_s^T(x)B_s^T(x) \end{pmatrix} \quad \begin{pmatrix} P + G^T - \\ \zeta(A_s(x)G + B_s(x)Z_s(x)) \end{pmatrix} \\ * \quad \zeta(G + G^T) \\ * \quad * \\ * \quad * \\ -G^T B_{1s}^T(x) - Z_s^T(x)D_s^T(x) \quad -B_{\infty s}(x)H(x) \\ -\zeta(G^T C_{1s}^T(x) + Z_s^T(x)D_s^T(x)) \quad 0 \\ -\gamma^2 I \quad -D_{\infty s}(x)H(x) \\ * \quad I + H(x) + H^T(x) \end{bmatrix}$$

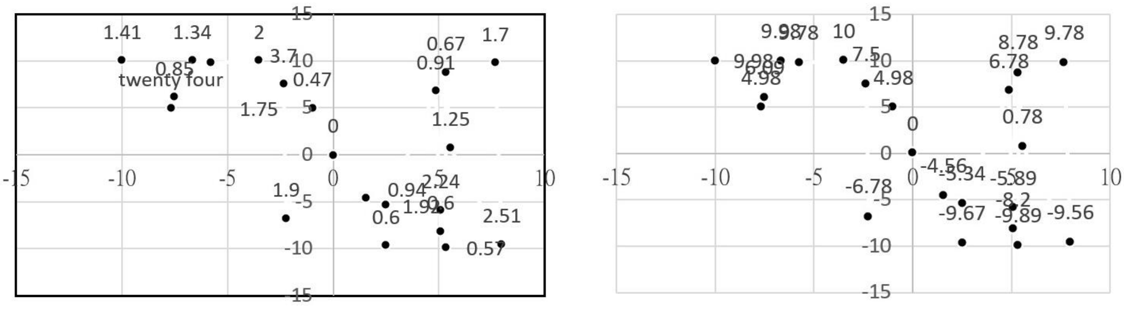
$$\Psi_{ij} = \begin{bmatrix} \begin{pmatrix} -A_s(x)G - G^T A_s^T(x) \\ -B_s(x)Z_j(x) - Z_j^T(x)B_s^T(x) \end{pmatrix} \quad \begin{pmatrix} P + G^T - \\ \zeta(A_s(x)G + B_s(x)Z_j(x)) \end{pmatrix} \\ * \quad \zeta(G + G^T) \\ * \quad * \\ * \quad * \\ -G^T C_{1s}^T(x) - Z_j^T(x)D_s^T(x) \quad -B_{\infty s}(x)H(x) \\ -\zeta(G^T C_{1s}^T(x) + Z_s^T(x)D_s^T(x)) \quad 0 \\ -\gamma^2 I \quad -D_{\infty s}(x)H(x) \\ * \quad I + H(x) + H^T(x) \end{bmatrix}$$

$$\Psi_{ji}=\begin{bmatrix} \begin{pmatrix} -A_j(x)G-G^TA_j^T(x) \\ -B_s(x)Z_j(x)-Z_j^T(x)B_s^T(x) \end{pmatrix} & \begin{pmatrix} P+G^T- \\ \zeta(A_j(x)G+B_j(x)Z_s(x)) \end{pmatrix} \\ * \quad \zeta(G+G^T) \\ * \quad * \\ * \quad * \\ -G^TC_{ij}^T(x)-Z_s^T(x)D_j^T(x) \quad -B_{\infty s}(x)H(x) \\ -\zeta(G^TC_{1j}^T(x)+Z_i^T(x)D_j^T(x)) \quad 0 \\ -\gamma^2 I \quad -D_{\infty s}(x)H(x) \\ * \quad I+H(x)+H^T(x) \end{bmatrix}$$

4. Example

In order to verify the validity of the problem model and algorithm, the article has done the following two parts of experiments: (1) Comparing the solution results of 18 small-scale calculation examples of CPLEX and ALNS algorithms, it proves the validity of the model and algorithm, (2) Using The ALNS algorithm solves the medium-scale calculation example with 50 requirements and the large-scale calculation example with 100 requirements, verifies the stability of ALNS in solving large-scale problems, and analyzes the impact of the joint distribution mode of trucks and UAVs on path costs.

There is no ready-made calculation example for the PDPTW-D problem studied in this article, three types of calculations of cluster distribution C, random distribution R and random cluster distribution RC are generated based on the examples of Sacramento and Li. The example is used as the test case of the article. The location and demand of customer points in the calculation example. Fig. 2 is a schematic diagram of calculation example generation, (a) is a schematic diagram of VRP-D, (b) is a PDPTW-D after pairing of pick-up and delivery nodes and adding a time window schematic diagram. In Fig. 2, the square symbol represents the distribution center, the circle symbol represents the delivery point, the triangle symbol represents the pick-up point, the number above the symbol in Fig. (a) represents the demand, and the number (n, m, t) represent the demand, the lower limit of the time window and the upper limit of the time window, respectively.



(a) (b)

Fig. 2 Schematic diagram of calculation example generation

Table 1 The solution results of small-scale calculation examples

AC		CPLEX			ALNS		
lc15-2	2	438.91	712.81	2	438.91	2.01	0
lr15-1	3	399.22	3600	3	333.88	4.48	-16.37
lr15-2	4	386.30	3600	4	333.37	2.74	-13.70
lrc15-1	4	432.55	3600	4	420.89	3.08	-2.70
lrc15-2	5	568.31	3600	5	531.19	2.38	-6.53
lc20-1	2	454.85	3600	2	461.58	3.42	1.48
lc20-2	2	431.81	3600	2	431.68	4.57	-0.03
lr20-1	5	678.82	3600	5	548.76	3.67	-19.16
lr20-2	5	581.00	3600	5	470.31	5.19	-19.05
lrc20-1	7	1043.94	3600	7	847.77	3.64	-18.79
lrc20-2	7	956.86	3600	7	779.44	4.46	-18.54

Test environment and parameter settings.

The computer configuration of the experiment is Intel Core I 5-7200U 2.5G H z, 4 GB memory, ALNS is written in C++ language, IDE adopts Visio Studio 2019 and CPLEX adopts the default setting of CPLEX12.8.

ALNS in the article are set as follows: the total number of iterations is 15000, the maximum number of unimproved iterations is 2000, and the operator weight update criterion parameters σ1=33, σ2=9, σ3=13. Simulated annealing temperature cooling rate a=0.99975.

Due to the excessive constraints and parameters of the model, even the small-scale calculation example CPLEX solver cannot solve all of them accurately, some calculation examples cannot obtain the optimal solution within a limited time, and the improvement of the solution after 3600 seconds is small, so The article limits the maximum running time of CPLEX to 3600 seconds, and verifies the effectiveness of the ALNS algorithm by comparing the solution results of CPLEX within 3600 seconds and the solution results of ALNS. In Table 1 to Table 3, AC represents the name of the calculation example, RN represents the number of paths, TC represents the total cost, RT represents the running time, Gap represents the deviation between the solution result of the ALNS algorithm and the solution result of CPLEX, and its value is (TC(ALNS)-TC(CPLEX))/TC(CPLEX).

18 small-scale calculation examples solved by CPLEX and ALNS are shown in Table 1. The bold font indicates the better running results of the two solution methods, and the negative Ga p indicates that the solution effect of the ALNS algorithm is better than that of CPLE X. From the results, there are 11 cases where the ALNS results are better than the CPLEX results, and the cost difference is up to 19.16%, there are 6 cases where the ALNS results are the same as the CPLEX results, only 1 case has the ALNS results Slightly worse than CPLE X. From the solution time point of view, the running time of ALNS is less than that of CPLE X. However, it is difficult for CPLEX to obtain the optimal solution for 20 requirements within 3600 seconds, while ALNS can obtain an accepted and effective solution within 5 seconds, which shows that the problem model proposed in the article and the ALNS algorithm are very effective for “truck+UAV”. Pick-up and delivery path planning in mode is effective.

In order to verify the stability of the ALNS algorithm for medium-scale and large-scale calculation examples, and analyze the impact of the joint distribution mode of trucks and drones on the route cost, the article analyzed three different types of type C, type R, and type RC, and 18

Table 2 Solution results of 50 groups of customer points

AC	Z PDPTW	Z IN	Z PDPTW-D	GAPI (%)	GAPD (%)
lc5_1	306.96	334.79	213.59	36.2	30.42
lc5_2	308.87	253.33	238.15	5.99	22.90
lc5_3	533.63	432.75	351.61	18.75	34.11
lc5_4	509.11	401.22	388.98	3.05	23.60
lc5_5	660.95	635.40	451.76	28.90	31.65
lc5_6	680.31	750.74	485.96	35.27	28.57
lr5_1	328.28	311.25	245.80	21.03	25.12
lr5_2	325.13	351.33	298.02	15.17	8.34
lr5_3	589.74	405.46	303.30	25.20	48.57
lr5_4	592.27	508.03	401.97	20.88	32.13
lr5_5	662.28	706.03	523.64	25.83	20.93
lr5_6	689.47	878.76	634.85	27.76	7.92
lrc5_1	324.99	289.89	267.58	7.70	17.67
lrc5_2	324.92	302.05	262.41	13.12	19.24
lrc5_3	586.11	426.83	359.71	15.73	38.63
lrc5_4	573.41	537.83	394.73	26.61	31.16
lrc5_5	673.99	744.16	482.48	35.16	28.41
lrc5_6	654.64	641.31	581.38	9.34	11.19

Table 3 Solution results of 100 groups of customer points

AC	Z PDPTW	Z IN	Z PDPTW-D	GAPI (%)	GAPD (%)
lc10_1	618.79	484.32	318.85	34.17	48.47
lc10_2	625.86	469.37	382.40	18.53	38.90
lc10_3	849.94	831.39	536.26	35.5	36.91
lc10_4	881.86	531.23	529.49	0.33	39.96
lc10_5	1303.36	1354.55	939.58	30.64	27.91
lc10_6	1270.10	1198.80	1095.59	8.61	13.74
lr10_1	653.58	503.07	408.28	18.84	37.53
lr10_2	629.12	503.91	437.12	13.25	30.52
lr10_3	1004.71	954.70	775.77	18.74	22.79
lr10_4	964.50	695.96	494.30	28.98	48.75
lr10_5	1348.08	1217.99	936.20	23.14	30.55
lr10_6	1310.74	1222.66	1091.43	10.73	16.73
lrc10_1	650.91	440.29	419.38	4.75	35.57
lrc10_2	625.76	572.70	420.67	26.55	32.77
lrc10_3	965.61	772.57	543.80	29.61	43.68
lrc10_4	936.99	784.86	725.66	7.54	22.55
lrc10_5	1371.91	1257.49	961.66	23.53	29.90
lrc10_6	1354.43	1096.57	1017.47	7.21	24.88

groups of 50 and 100 requirements are tested, and the calculation results are shown in Table 2 and Table 3.

In Table 2 and Table 3, Z IN Indicates the path cost of the initial solution in the joint distribution mode of trucks and UAVs, Z PDPTW Indicates the path cost for truck- only deliveries, Z PDPTW-D Indicates the path cost of the final solution in the joint distribution mode of trucks and UAVs, GAPI means and Z IN Compared to Z PDPTW-D Saved path cost, its value is (Z IN -Z PDPTW-D) / Z IN, GAPD is expressed with Z PDPTW Compared to Z PDPTW-D The path cost saved is (Z PDPTW -Z PDPTW-D) / Z PDPTW.

It can be seen from Table 2 that the GAPI and GAPD values of the three different types of data of R, C and RC are greater than 0. The ALNS algorithm improves the initial solution by 15%-30%, and the initial solution is increased by 36.20% at the highest, indicating that ALNS can avoid local optimum and obtain a better solution, the joint distribution mode of trucks and drones saves path costs 15%-35%, the highest saving is 48.57%, indicating that the joint distribution of trucks and drones can save a lot of path costs compared with pure truck distribution, and the effectiveness and necessity of drones for medium-scale PDPTW problems.

from table 3 It can be seen in R class, C class, RC Three different types of data are derived from GAPI and GAPD Values greater than 0, ALNS

Improve the initial solution by about 5%-30%, ALNS The highest improvement of the initial solution is 34.17%, indicating that ALNS In avoiding local optima and obtaining better

The effectiveness of the solution, the joint distribution of trucks and drones saves 20%-40% of the path cost, and the maximum savings is 48.75%, indicating that the joint distribution of trucks and drones can save a lot of route costs compared with pure truck distribution., the effectiveness and necessity of UAVs for large-scale PDPTW problems.

By testing and solving three different types of medium-scale and large-scale calculation examples of type C, type R, and type RC, it can be seen that the ALNS algorithm improves the initial solution by about 15%-30%, and the performance of the algorithm is relatively stable. ALNS can Avoid local optima and obtain a better solution, the joint distribution of trucks and UAVs saves about 20%-35% of the path cost, indicating that the “truck+UAV “transportation mode can save a lot of path costs. In PDPTW In the problem, using the “truck+UAV” transportation mode can solve different types and different scales of calculation examples, and provide decision-making basis for the path planning of the actual “truck+UAV” mode for picking and delivering goods.

5. Conclusions

The PDPTW-D problem was studied, and the model of the model was proposed. By designing a variety of efficient damage operators and repair operators based on the characteristics of the model, an adaptive large neighborhood search algorithm was designed to solve it, and the simulated annealing algorithm was used to solve the problem. Prevent the algorithm from getting stuck locally. The efficiency of the algorithm is verified by comparing the running results of small-scale calculation examples with CPLEX, and the stability and effectiveness of the algorithm are verified through medium-scale calculation examples and large-scale calculation examples. Through the analysis of the results, the joint distribution model of trucks and UAVs can effectively reduce the path cost. In practical applications, it can improve the efficiency of picking and delivering goods in the logistics network and provide a basis for the path planning of the “truck+UAV” model. Decision basis. Subsequent research questions will consider the impact of cargo weight on truck transportation rate and UAV transportation mileage, as well as factors such as soft time windows, to enrich the research scenarios of the problem.

References

Abad, F., Rouzegar, J. and Lotfian, S. (2023), "Application of the exact spectral element method in the analysis of the smart functionally graded plate", *Steel Compos. Struct.*, **47**(2), 297-313. https://doi.org/10.12989/scs.2023.47.2.297.

Akbari, A. (2023), "Seismic performance evaluation of steel moment resisting frames with mid-span rigid rocking cores", *Steel Compos. Struct.*, **46**(5), 621-635. https://doi.org/10.12989/scs.2023.46.5.621.

Aksoylu, C., Ozkilic, Y.O., Yazman, Ş., Alsdudi, M., Gemi, L. and Arslan, M.H. (2023), "Numerical and analytical investigation of parameters influencing the behavior of shear beams strengthened by CFRP wrapping", *Steel Compos. Struct.*, **47**(2), 217. https://doi.org/10.12989/scs.2023.47.2.217.

Al-Jaafari, M.A., Ahmed, R.A., Fenjan, R.M. and Faleh, N.M. (2023), "Nonlinear dynamic characteristic of sandwich graphene platelet reinforced plates with square honeycomb core", *Steel Compos. Struct.*, **46**(5), 659. https://doi.org/10.12989/scs.2023.46.5.659.

Ayough, P., Wang, Y.H. and Ibrahim, Z. (2023), "Analytical study of concrete-filled steel tubular stub columns with double inner steel tubes", *Steel Compos. Struct.*, **47**(5), 645. https://doi.org/10.12989/scs.2023.47.5.645.

Bai, L., Wei, H., Wang, B., Liao, F., Zhou, T. and Liang, X. (2023), "Mechanical behavior of steel tube encased high-strength concrete composite walls under constant axial load and cyclically increasing lateral load: Experimental investigation and modeling", *Steel Compos. Struct.*, **47**(1), 37. https://doi.org/10.12989/scs.2023.47.1.037.

Banh, T.T., Nam, L.G. and Lee, D. (2023), "A smooth boundary scheme-based topology optimization for functionally graded structures with discontinuities", *Steel Compos. Struct.*, **48**(1), 73-88. https://doi.org/10.12989/scs.2023.48.1.073.

Behshad, A., Shokravi, M., Alavijeh, A.S. and Karami, H. (2023), "Elastic wave propagation analysis in sandwich nanoplate assuming size effects", *Steel Compos. Struct.*, **47**(1), 71. https://doi.org/10.12989/scs.2023.47.1.071.

Biao, N., Shanhua, X., WeiCheng, H., HuaPeng, C., AnBang, L. and ZongXing, Z. (2023), "Elastic local buckling behaviour of corroded cold-formed steel columns", *Steel Compos. Struct.*, **48**(1), 27. https://doi.org/10.12989/scs.2023.48.1.027.

Bounouara, F., Sadoun, M., Saleh, M.M.S., Chikh, A., Bousahla, A.A., Kaci, A., ... & Tounsi, A. (2023), "Effect of visco-Pasternak foundation on thermo-mechanical bending response of anisotropic thick laminated composite plates", *Steel Compos. Struct.*, **47**(6), 693-707. https://doi.org/10.12989/scs.2023.47.6.693.

Canovas-Gonzalez, M., García-Guerrero, J.M. and Jorquera-Lucerga, J.J. (2023), "Validity of the Nielsen-type hanger arrangement in spatial arch bridges with straight decks", *Steel Compos. Struct.*, **47**(1), 51. https://doi.org/10.12989/scs.2023.47.1.051.

Chandrasekaran, A. and Nambiappan, U. (2023), "Experimental investigations on resilient beam-column end-plate connection with structural fuse", *Steel Compos. Struct.*, **47**(3), 315. https://doi.org/10.12989/scs.2023.47.3.315.

Chen, B., Cao, L., Lu, F. and Chen, Y.F. (2023), "Experimental study on vibration serviceability of cold-formed thin-walled steel floor", *Steel Compos. Struct.*, **46**(4), 577. https://doi.org/10.12989/scs.2023.46.4.577.

Chen, C. (2006), "Numerical model of internal solitary wave evolution on impermeable variable seabed in a stratified two-layer fluid system", *Chin Ocean Eng*, **20**(2), 303-313.

Chen, C. (2006), "S-curve regression of fuzzy method and statistical application", *Proceedings of the 10 th IASTED International Conference on Artificial Intelligence and Soft Computing*.

Chen, C., Hsu, R. and Chen, C. (2006), "Energy dissipation and velocity distribution of internal soliton encountering submerged triangular obstacle", *Journal of Southwest Jiaotong University*.

Chen, C.W. (2006), "Stability conditions of fuzzy systems and its application to structural and mechanical systems", *Adv. Eng. Softw.*, **37**(9), 624-629. https://doi.org/10.1016/j.advengsoft.2005.12.002.

Chen, C.W. (2009), "Modeling and control for nonlinear structural systems via a NN-based approach", *Exp. Syst. Appl.*, **36**(3), 4765-4772. https://doi.org/10.1016/j.eswa.2008.06.062.
Chen, C.W. (2009), "The stability of an oceanic structure with T–S fuzzy models", *Math. Comput. Simul.*, **80**(2), 402-426. https://doi.org/10.1016/j.matcom.2009.08.001.
Chen, C.W. (2010), "Application of fuzzy-model-based control to nonlinear structural systems with time delay: An LMI method", *J. Vib. Control*, **16**(11), 1651-1672. https://doi.org/10.1177/1077546309104185.
Chen, C.W. (2010), "Modeling and fuzzy PDC control and its application to an oscillatory TLP structure", *Math. Prob. Eng.*, **2010**, Article ID 120403. https://doi.org/10.1155/2010/120403.
Chen, C.W. (2011), "A critical review of nonlinear fuzzy multiple time-delay interconnected systems using the Lyapunov criterion", *Scientif. Res. Essay.*, **6**(28), 5917-5932. https://doi.org/10.5897/SRE11.1347.
Chen, C.W. (2011), "A critical review of parallel distributed computing and the Lyapunov criterion for multiple time-delay fuzzy systems", *Int. J. Phys. Sci.*, **6**(19), 4492-4501. https://doi.org/10.5897/IJPS11.908.
Chen, C.W. (2011), "Internet services and interface design for marketing: A preliminary study of Cliven products", *Int. J. Phys. Sci.*, **6**(15), 3585-3596. https://doi.org/10.5897/IJPS11.606.
Chen, C.W. (2011), "Modeling, control, and stability analysis for time-delay TLP systems using the fuzzy Lyapunov method", *Neur. Comput. Appl.*, **20**, 527-534. https://doi.org/10.1007/s00521-011-0576-8.
Chen, C.W. (2011), "Stability analysis and robustness design of nonlinear systems: an NN-based approach", *Appl. Soft Comput.*, **11**(2), 2735-2742. https://doi.org/10.1016/j.asoc.2010.11.004.
Chen, C.W. (2013), "A study of PDC fuzzy control of structural systems using LMI approach", *Proceedings of the IASTED International Conference, Applied Informatics*.
Chen, C.W. (2014), "A criterion of robustness intelligent nonlinear control for multiple time-delay systems based on fuzzy Lyapunov methods", *Nonlin. Dyn.*, **76**, 23-31. https://doi.org/10.1007/s11071-013-0869-9.
Chen, C.W. (2014), "Interconnected TS fuzzy technique for nonlinear time-delay structural systems", *Nonlin. Dyn.*, **76**, 13-22. https://doi.org/10.1007/s11071-013-0841-8.
Chen, C.W. (2015), "Smart monitoring system with multi-criteria decision using a feature based computer vision technique", *Smart Struct. Syst.*, **15**(6), 1583-1600. https://doi.org/10.12989/sss.2015.15.6.1583.
Chen, C.W. (2015), "Structural system simulation and control via NN based fuzzy model", *Struct. Eng. Mech.*, **56**(3), 385-407. https://doi.org/10.12989/sem.2015.56.3.385.
Chen, C.W. and Chen, C.Y. (2008), "Stability analysis for time delay TLP systems", 2008 IEEE/ASME International Conference on Advanced Intelligent Mechatronics, 1103-1107. https://doi.org/10.1109/AIM.2008.4601816.
Chen, C.W. and Chen, P.C. (2010), "GA-based adaptive neural network controllers for nonlinear systems", *Int. J. Innov. Comput., Inform. Control*, **6**(4), 1793-1803.
Chen, C.W. and Tseng, C.P. (2012), "Default risk-based probabilistic decision model for risk management and control", *Nat. Hazard.*, **63**, 659-671. https://doi.org/10.1007/s11069-012-0183-8.
Chen, C.W., Chang, M.L. and Tseng, C.P. (2012), "Retracted: Human factors of knowledge-sharing intention among taiwanese enterprises: A model of hypotheses", *Human Fact. Ergonom. Manuf. Serv. Industr.*, **22**(4), 362-371. https://doi.org/10.1002/hfm.20286.
Chen, C.W., Chang, M.L., Tseng, C.P., Chen, B.C. and Chang, Y.Y.C. (2013), "Retracted: Critical human factor evaluation of knowledge sharing intention in Taiwanese enterprises", *Human Fact. Ergonom. Manuf. Serv. Industr.*, **23**(2), 95-106. https://doi.org/10.1002/hfm.20300.
Chen, C.W., Chen, C.Y., Hsien-Chueh Yang, P. and Chen, T.H. (2007), "Analysis of experimental data on internal waves with statistical method", *Eng. Comput.*, **24**(2), 116-150. https://doi.org/10.1108/02644400710729536.
Chen, C.W., Chen, C.Y., Tseng, C.P. and Tsai, C.H. (2007), "Application of fuzzy stability control for buildings", *Artif. Intel. Appl.*, 592-597.
Chen, C.W., Chen, C.Y., Wang, M.H., Yeh, K. and Hsieh, T.Y. (2004), "Fuzzy regression to construction management via TS fuzzy model", *Artificial Intelligence and Applications: IASTED International Conference Proceedings, as Part of the 22nd IASTED International Multi-Conference on Applied Informatics*.

Chen, C.W., Chen, P.C. and Chiang, W.L. (2011), "Stabilization of adaptive neural network controllers for nonlinear structural systems using a singular perturbation approach", *J. Vib. Control*, **17**(8), 1241-1252. https://doi.org/10.1177/1077546309352827.
Chen, C.W., Chiang, W.L. and Hsiao, F.H. (2004), "Stability analysis of T–S fuzzy models for nonlinear multiple time-delay interconnected systems", *Math. Comput. Simul.*, **66**(6), 523-537. https://doi.org/10.1016/j.matcom.2004.04.001.
Chen, C.W., Chiang, W.L., Hsiao, F.H. and Tsai, C.H. (2004), "H/sup/spl infin//fuzzy control of structural systems using Takagi-Sugeno fuzzy model", *Proceedings of the IEEE International Conference on Mechatronics, ICM'04*, 340-345.
Chen, C.W., Chiang, W.L., Tsai, C.H., Chen, C.Y. and Wang, M.H. (2006), "Fuzzy Lyapunov method for stability conditions of nonlinear systems", *Int. J. Artif. Intel. Tool.*, **15**(02), 163-171. https://doi.org/10.1142/S0218213006002618.
Chen, C.W., Chiang, W.L., Yeh, K., Chen, Z.Y. and Lu, L.T. (2002), "A stability criterion of time-delay fuzzy systems", *J. Marine Sci. Technol.*, **10**(1), 5.
Chen, C.W., Lee, C.C., Chen, C.H. and Tseng, C.P. (2013), "The integration of nautical hazard assessment and harbor GIS models to the Taichung Port area in Taiwan", *Nat. Hazard.*, **67**, 275-294. https://doi.org/10.1007/s11069-013-0559-4.
Chen, C.W., Lee, C.C., Tseng, C.P. and Chen, C.H. (2013), "Application of GIS for the determination of hazard hotspots after direct transportation linkages between Taiwan and China", *Nat. Hazard.*, **66**, 191-228. https://doi.org/10.1007/s11069-012-0402-3.
Chen, C.W., Lee, K.L., Tseng, C.P., Yang, H.C. and Liu, C.C. (2013), "Retracted: The relationship between personality traits and sales force automation usage: A preliminary study", *Human Fact. Ergonom. Manuf. Serv. Industr.*, **23**(3), 243-253. https://doi.org/10.1002/hfm.20313.
Chen, C.W., Lin, C.L., Tsai, C.H., Chen, C.Y. and Yeh, K. (2007), "A novel delay-dependent criterion for time-delay TS fuzzy systems using fuzzy Lyapunov method", *Int. J. Artif. Intel. Tool.*, **16**(03), 545-552. https://doi.org/10.1142/S0218213007003400.
Chen, C.W., Lin, C.L., Tsai, C.H., Chen, C.Y. and Yeh, K. (2007), "A novel delay-dependent criterion for time-delay TS fuzzy systems using fuzzy Lyapunov method", *Int. J. Artif. Intel. Tool.*, **16**(03), 545-552.
Chen, C.W., Liu, K.F.R., Lin, M.L. and Tseng, C.P. (2013), "A new viewpoint of hazard assessment and management for Taiwan's insurance issues", *Nat. Hazard.*, **65**, 303-314. https://doi.org/10.1007/s11069-012-0363-6.
Chen, C.W., Liu, K.F.R., Tseng, C.P., Hsu, W.K. and Chiang, W.L. (2012), "Hazard management and risk design by optimal statistical analysis", *Nat. Hazard.*, **64**, 1707-1716. https://doi.org/10.1007/s11069-012-0329-8.
Chen, C.W., Shen, C.W., Chen, C.Y. and Cheng, M.J. (2010), "Stability analysis of an oceanic structure using the Lyapunov method", *Eng. Comput.*, **27**(2), 186-204. https://doi.org/10.1108/02644401011022364.
Chen, C.W., Tsai, C.H., Tseng, C.B., Lin, S.G., Wang, M.H.L. and Chung, P.Y. (2002), "Application of modeling and control to structural systems", *Proc.-Contr. Theory Appl.*, **149**, 1-10.
Chen, C.W., Tsai, C.H., Tseng, C.P., Wang, M.H.L. and Chung, P.Y. (2002), "A novel fuzzy regression approach on managing target cash balance for construction firms", *17th IASTED International Conference on Modeling and Simulation*, Montreal, Canada.
Chen, C.W., Tseng, C.P., Hsu, W.K. and Chiang, W.L. (2012), "A novel strategy to determine the insurance and risk control plan for natural disaster risk management", *Nat. Hazard.*, **64**, 1391-1403. https://doi.org/10.1007/s11069-012-0305-3.
Chen, C.W., Tseng, C.P., Lee, K.L. and Yang, H.C. (2011), "Conceptual framework and research method for personality traits and sales force automation usage", *Scientif. Res. Essay.*, **6**(17), 3784-3793. https://doi.org/10.5897/sre11.1022.
Chen, C.W., Wang, M.H. and Lin, J.W. (2009), "Managing target the cash balance in construction firms using a fuzzy regression approach", *Int. J. Uncertain., Fuzz. Knowled.-Bas. Syst.*, **17**(05), 667-684. https://doi.org/10.1142/S0218488509006200.

Chen, C.W., Yang, H.C., Chen, C.H., Tseng, C.P. and Lee, K.L. (2013), "Retracted: The relationship between personality traits and sales force automation usage: A Review of Methodology", *Human Fact. Ergonom. Manuf. Serv. Industr.*, **23**(4), 294-305. https://doi.org/10.1002/hfm.20311.
Chen, C.W., Yeh, K. and Liu, K.F.R. (2009), "Adaptive fuzzy sliding mode control for seismically excited bridges with lead rubber bearing isolation", *Int. J. Uncertain., Fuzz. Knowled.-Bas. Syst.*, **17**(05), 705-727. https://doi.org/10.1142/S0218488509006224.
Chen, C.W., Yeh, K., Chen, Z.Y., Huang, J.D. and Chiang, W.L. (2002, December), "Model-based fuzzy control for nonlinear tuned mass damper systems with multiple time delays", *2002 IEEE International Conference on Industrial Technology, IEEE ICIT'02*, **1**, 60-65. https://doi.org/10.1109/ICIT.2002.1189862.
Chen, C.W., Yeh, K., Chiang, W.L., Chen, C.Y. and Wu, D.J. (2007), "Modeling, H∞ control and stability analysis for structural systems using Takagi-Sugeno fuzzy model", *J. Vib. Control*, **13**(11), 1519-1534. https://doi.org/10.1177/1077546307073690.
Chen, C.Y., Chen, C.W. and Tseng, I.F. (2007), "Localized mixing due to an interfacial solitary wave breaking on seabed topography in different ridge heights", *J. Offshore Mech. Arct. Eng*., **129**(3), 245-250. https://doi.org/10.1115/1.2426991.
Chen, C.Y., Chen, C.W., Yeh, K. and Tseng, C.P. (2007), "Stability analysis for floating structures using TS fuzzy control", *Advanced Intelligent Computing Theories and Applications. With Aspects of Artificial Intelligence: Third International Conference on Intelligent Computing, ICIC 2007*, Qingdao, China, August. https://doi.org/10.1007/978-3-540-74205-0_79.
Chen, C.Y., Hsu, J.R.C. and Chen, C.W. (2005), "Fuzzy logic derivation of neural network models with time delays in subsystems", *Int. J. Artif. Intel. Tool.*, **14**(06), 967-974. https://doi.org/10.1142/S021821300500248X.
Chen, C.Y., Hsu, J.R.C., Chen, C.W., Chen, H.H., Kuo, C.F. and Cheng, M.H. (2007), "Generation of internal solitary wave by gravity collapse", *J. Marine Sci. Technol.*, **15**(1), 1.
Chen, C.Y., Hsu, J.R.C., Chen, C.W., Kuo, C.F., Chen, H.H. and Cheng, M.H. (2007), "Wave propagation at the interface of a two-layer fluid system in the laboratory", *J. Marine Sci. Technol.*, **15**(1), 2.
Chen, C.Y., Hsu, J.R.C., Chen, H.H., Kuo, C.F. and Cheng, M.H. (2007), "Laboratory observations on internal solitary wave evolution on steep and inverse uniform slopes", *Ocean Eng.*, **34**(1), 157-170. https://doi.org/10.1016/j.oceaneng.2005.11.019.
Chen, C.Y., Hsu, J.R.C., Cheng, M.H. and Chen, C.W. (2008), "Experiments on mixing and dissipation in internal solitary waves over two triangular obstacles", *Environ. Fluid Mech.*, **8**, 199-214. https://doi.org/10.1007/s10652-008-9055-x.
Chen, C.Y., Lee, C.P. and Chen, C.W. (2002), "On the permeability inside the granular media", *J. Marine Sci. Technol.*, **10**(2), 9.
Chen, C.Y., Lee, W.I., Kuo, H.M., Chen, C.W. and Chen, K.H. (2010), "The study of a forecasting sales model for fresh food", *Exp. Syst. Appl.*, **37**(12), 7696-7702. https://doi.org/10.1016/j.eswa.2010.04.072.
Chen, C.Y., Lee, W.I., Sui, Y.C. and Chen, C.W. (2010), "Applying half-circle fuzzy numbers to control system: a preliminary study on development of intelligent system on marine environment and engineering", *Int. J. Marine Environ. Sci.*, **4**(12), 1980-1984.
Chen, C.Y., Lin, J.W., Lee, W.I. and Chen, C.W. (2010), "Fuzzy control for an oceanic structure: a case study in time-delay TLP system", *J. Vib. Control*, **16**(1), 147-160. https://doi.org/10.1177/1077546309339424.
Chen, C.Y., Shen, C.W., Chen, C.W., Liu, K.F.R. and Jeng, M.J. (2009), "A stability criterion for time-delay tension leg platform systems subjected to external force", *China Ocean Eng.*, **23**(1), 49-57.
Chen, C.Y., Tseng, I.F., Yang, H.C.P., Chen, C.W. and Chen, T.H. (2006), "Profile evolution and energy dissipation for internal soliton transmitting over different submarine ridges", *China Ocean Eng.*, **20**(4), 585-594.
Chen, C.Y., Yang, H.C.P., Chen, C.W. and Chen, T.H. (2008), "Diagnosing and revising logistic regression models: effect on internal solitary wave propagation", *Eng. Comput.*, **25**(2), 121-139. https://doi.org/10.1108/02644400810855940.
Chen, C.Y., Yang, Y.F., Chen, C.W., Chen, L.T. and Chen, T.H. (2010), "Linking the balanced scorecard (BSC) to business management performance: A preliminary concept of fit theory for navigation science

and management", *Int. J. Phys. Sci.*, **5**(8), 1296-1305.
Chen, P.C., Chen, C.W. and Chiang, W.L. (2008), "GA-based fuzzy sliding mode controller for nonlinear systems", *Math. Prob. Eng.*, **2008**, Article ID 325859. https://doi.org/10.1155/2008/325859.
Chen, P.C., Chen, C.W. and Chiang, W.L. (2009), "GA-based modified adaptive fuzzy sliding mode controller for nonlinear systems", *Exp. Syst. Appl.*, **36**(3), 5872-5879. https://doi.org/10.1016/j.eswa.2008.07.003.
Chen, P.C., Chen, C.W. and Chiang, W.L. (2011), "Linear matrix inequality conditions of nonlinear systems by genetic algorithm-based H∞ adaptive fuzzy sliding mode controller", *J. Vib. Control*, **17**(2), 163-173. https://doi.org/10.1177/1077546309352826.
Chen, P.C., Chen, C.W., Chiang, W.L. and Lo, D.C. (2011), "GA-based decoupled adaptive FSMC for nonlinear systems by a singular perturbation scheme", *Neur. Comput. Appl.*, **20**, 517-526. https://doi.org/10.1007/s00521-011-0540-7.
Chen, P.C., Yeh, K., Chen, C.W. and Chen, C.Y. (2009), "Application to GA-based fuzzy control for nonlinear systems with uncertainty", *2009 First Asian Conference on Intelligent Information and Database Systems*, 249-252. https://doi.org/10.1109/ACIIDS.2009.86.
Chen, P.C., Yeh, K., Chen, C.W. and Lin, S.H. (2009), "Stability analysis of fuzzy control for nonlinear systems", *2009 First Asian Conference on Intelligent Information and Database Systems*, 238-242. https://doi.org/10.1109/ACIIDS.2009.83.
Chen, T.H. and Chen, C.W. (2010), "Application of data mining to the spatial heterogeneity of foreclosed mortgages", *Exp. Syst. Appl.*, **37**(2), 993-997. https://doi.org/10.1016/j.eswa.2009.05.076.
Chen, T.H., Chen, C.Y., Yang, H.C.P. and Chen, C.W. (2008), "A mathematical tool for inference in logistic regression with small-sized data sets: A practical application on ISW-ridge relationships", *Math. Prob. Eng.*, **2008**, Article ID 186372. https://doi.org/10.1155/2008/186372.
Chen, T.H., Yang, H.C., Chen, C.Y. and Chen, C.W. (2009), "Application of logistic regression model: propagation effect on internal soliton", *J. Chung Cheng Inst. Technol.*, **37**, 1-10.
Chen, Y., Jiang, Z., Xu, Q. and Ren, C. (2023), "Experimental study on fatigue behavior of innovative hollow composite bridge slabs", *Steel Compos. Struct.*, **46**(6), 745. https://doi.org/10.12989/scs.2023.46.6.745.
Chen, Z.Y., Chen, C.W., Chiang, W.L. and Huang, J.D. (2002), "Fuzzy control for nonlinear systems modeled via neural-network", *2002 IEEE International Conference on Industrial Technology*, **1**, 66-71. https://doi.org/10.1109/ICIT.2002.1189863.
Cheng, M.H., Hsu, J.R.C., Chen, C.Y. and Chen, C.W. (2009), "Modelling the propagation of an internal solitary wave across double ridges and a shelf-slope", *Environ. Fluid Mech.*, **9**, 321-340. https://doi.org/10.1007/s10652-008-9104-5.
Cheng, X. and Wu, Y. (2023), "On wave propagation of football ball in the free kick and the factors affecting it", *Steel Compos. Struct.*, **46**(5), 669. https://doi.org/10.12989/scs.2023.46.5.669.
Chen-yuan, C.H.E.N., Rong-chung, H.J. and Cheng-wu, C.H.E.N. (2007), "Interfacial wave motion in an impermeable rigid channel with stratified density fluid system, 2, Waveform feature against stratification thickness ratio", *Adv. Water Sci.*, **18**(4), 575-579.
Chen-yuan, C.H.E.N., Rong-chung, H.J. and Cheng-wu, C.H.E.N. (2007), "Interfacial wave motion in an impermeable rigid channel with stratified density fluid system, 1, Wave evolution related to various energy conditions", *Adv. Water Sci.*, **18**(4), 570-574.
Chiang, W.L. (2010), "A neural-network approach to modeling and analysis", *Proceedings of the International Conference on Tools with Artificial Intelligence*.
Chiang, W.L., Chen, T.W., Liu, M.Y. and Hsu, C.J. (2001), "Application and robust H?? control of PDC fuzzy controller for nonlinear systems with external disturbance", *J. Marine Sci. Technol.*, **9**(2), 3.
Chiang, W.L., Chiou, D.J., Chen, C.W., Tang, J.P., Hsu, W.K. and Liu, T.Y. (2010), "Detecting the sensitivity of structural damage based on the Hilbert-Huang transform approach", *Eng. Comput.*, **27**(7), 799-818. https://doi.org/10.1108/02644401011073665.
Chiou, D.J., Hsu, W.K., Chen, C.W., Hsieh, C.M., Tang, J.P. and Chiang, W.L. (2011), "Applications of Hilbert-Huang transform to structural damage detection", *Struct. Eng. Mech.*, **39**(1), 1-20.

https://doi.org/10.12989/sem.2011.39.1.001.

Dong, F., Xu, W., Wu, Z. and Hou, J. (2023), “Finite element computer simulation of twinning caused by plastic deformation of sheet metal”, *Steel Compos. Struct.*, **47**(5), 601. https://doi.org/10.12989/scs.2023.47.5.601.

Fard, K.M. and Mahmoudi, M. (2023), “Energy absorption optimization on a sandwich panel with lattice core under the low-velocity impact”, *Steel Compos. Struct.*, **46**(4), 525-538. https://doi.org/10.12989/scs.2023.46.4.525.

Ferraioli, M., Biagio, L., Angelo, L., Frattolillo, C. and De Matteis, G. (2023), “Seismic retrofit of a steel-reinforced concrete hospital building using continuous energy-dissipative steel columns”, *Steel Compos. Struct.*, **47**(4), 467-488. https://doi.org/10.12989/scs.2023.47.4.467.

Foroutan, K. and Dai, L. (2023), “Nonlinear vibration and primary resonance of multilayer functionally graded shallow shells with porous core”, *Steel Compos. Struct.*, **48**(3), 335. https://doi.org/10.12989/scs.2023.48.3.335.

Gholizadeh, S., Milany, A. and Hasançebi, O. (2023), “Seismic optimization and performance assessment of special steel moment-resisting frames considering nonlinear soil-structure interaction”, *Steel Compos. Struct.*, **47**(3), 339. https://doi.org/10.12989/scs.2023.47.3.339.

Han, S.W., Cho, S.I., Kim, T. and Lee, K. (2023), “Moment ratio considering composite beam action for steel special moment frames”, *Steel Compos. Struct.*, **47**(4), 489. https://doi.org/10.12989/scs.2023.47.4.489.

He, B., Wen, S., Feng, Y., Jiang, L. and Zhoud, W. (2023), “Reliability of mortar filling layer void length in in-service ballastless track-bridge system of HSR”, *Steel Compos. Struct.*, **47**(1), 91-102. https://doi.org/10.12989/scs.2023.47.1.091.

He, J., Zhang, X., Gong, H., Ali, H.E. and Ali, E. (2023), “Levy-type solution for analysis of a magneto-electro-elastic panel”, *Steel Compos. Struct.*, **46**(6), 719. 10.12989/scs.2023.46.6.719.

He, X., Yam, M.C., Ke, K., Zhou, X., Zhang, H. and Gu, Z. (2023), “Behaviour insights on damage-control composite beam-to-beam connections with replaceable elements”, *Steel Compos. Struct.*, **46**(6), 773. https://doi.org/10.12989/scs.2023.46.6.773.

Hong, T.T., Thai, D.K. and Kim, S.E. (2023), “An evaluation system for determining the stress redistribution of a steel cable-stayed bridge due to cable stress relaxation at various temperatures”, *Steel Compos. Struct.*, **46**(6), 805. https://doi.org/10.12989/scs.2023.46.6.805.

Hsiao, F.H. and Hwang, J.D. (2003), “Robustness design of fuzzy controllers for nonlinear interconnected systems”, *SICE Annual Conference Program and Abstracts SICE Annual Conference 2003*, 34-34.

Hsiao, F.H., Chen, C.W., Liang, Y.W., Xu, S.D. and Chiang, W.L. (2005), “TS fuzzy controllers for nonlinear interconnected systems with multiple time delays”, *IEEE Trans. Circuit. Syst. I: Regular Papers*, **52**(9), 1883-1893. https://doi.org/10.1109/TCSI.2005.852492.

Hsiao, F.H., Chen, C.W., Wu, Y.H. and Chiang, W.L. (2005), “Fuzzy controllers for nonlinear interconnected TMD systems with external force”, *J. Chin. Inst. Eng.*, **28**(1), 175-181. https://doi.org/10.1080/02533839.2005.9670984.

Hsiao, F.H., Chiang, W.L. and Chen, C.W. (2005). Fuzzy control for nonlinear systems via neural-network-based approach”, *Int. J. Comput. Meth. Eng. Sci. Mech.*, **6**(3), 145-152. https://doi.org/10.1080/15502280590923612.

Hsiao, F.H., Chiang, W.L., Chen, C.W., Xu, S.D. and Wu, S.L. (2005), “Application and robustness design of fuzzy controller for resonant and chaotic systems with external disturbance”, *Int. J. Uncertain., Fuzz. Knowled.-Bas. Syst.*, **13**(03), 281-295. https://doi.org/10.1142/S0218488505003461.

Hsiao, F.H., Hwang, J.D. and Chen, C.W. (2004), “Decentralized fuzzy control for nonlinear multiple time-delay large-scale systems”, *SICE 2004 Annual Conference*, **3**, 2806-2810.

Hsiao, F.H., Hwang, J.D., Chen, C.W. and Tsai, Z.R. (2005), “Robust stabilization of nonlinear multiple time-delay large-scale systems via decentralized fuzzy control”, *IEEE Trans. Fuzzy Syst.*, **13**(1), 152-163. https://doi.org/10.1109/TFUZZ.2004.836067.

Hsieh, T.Y., Wang, M.H., Chen, C.W., Chen, C.Y., Yu, S.E., Yang, H.C. and Chen, T.H. (2006), “A new viewpoint of s-curve regression model and its application to construction management”, *Int. J. Artif. Intel.*

Tool., **15**(02), 131-142. https://doi.org/10.1142/S021821300600259X.
Hsieh, T.Y., Wang, M.H.L. and Chen, C.W. (2004), "A case study of S-curve regression method to project control of construction management via TS fuzzy model", *J. Marine Sci. Technol.*, **12**(3), 10.
Hsu, M.H., Su, K.W., Chang, C.J., Chen, C.Y., Lai, C.Y., Hunag, A. and Chen, C.W. (2013), "Routing protocol performance evaluation in wireless Ad hoc network", *Inform. Technol. J.*, **12**(22), 6595.
Hsu, W.K., Chiang, W.L. and Chen, C.W. (2013), "Earthquake risk assessment and optimal risk management strategies for hi-tech fabs in Taiwan", *Nat. Hazard.*, **65**, 2063-2076. https://doi.org/10.1007/s11069-012-0462-4.
Hsu, W.K., Chiang, W.L., Xue, Q., Hung, D.M., Huang, P.C., Chen, C.W. and Tsai, C.H. (2013), "A probabilistic approach for earthquake risk assessment based on an engineering insurance portfolio", *Nat. Hazard.*, **65**, 1559-1571. https://doi.org/10.1007/s11069-012-0425-9.
Hsu, W.K., Chiou, D.J., Chen, C.W., Liu, M.Y., Chiang, W.L. and Huang, P.C. (2014), "A case study of damage detection in four-bays steel structures using the HHT approach", *Smart Struct. Syst.*, **14**(4), 595-615. https://doi.org/10.12989/sss.2014.14.4.595.
Hsu, W.K., Huang, P.C., Chang, C.C., Chen, C.W., Hung, D.M. and Chiang, W.L. (2011), "An integrated flood risk assessment model for property insurance industry in Taiwan", *Nat. Hazard.*, **58**, 1295-1309. https://doi.org/10.1007/s11069-011-9732-9.
Hsu, W.K., Tseng, C.P., Chiang, W.L. and Chen, C.W. (2012), "Risk and uncertainty analysis in the planning stages of a risk decision-making process", *Nat. Hazard.*, **61**, 1355-1365. https://doi.org/10.1007/s11069-011-0032-1.
Huang, C.F., Wang, M.H. and Chen, C.W. (2007), "Managing target cash balance in construction firms using novel fuzzy regression approach", *Advanced Intelligent Computing Theories and Applications. With Aspects of Artificial Intelligence: Third International Conference on Intelligent Computing, ICIC 2007*, Qingdao, China, August. https://doi.org/10.1007/978-3-540-74205-0_74.
Im, C.R., Kim, S., Yang, K.H., Mun, J.H., Oh, J.H. and Sim, J.I. (2023), "Cyclic loading test for concrete-filled hollow PC column produced using various inner molds", *Steel Compos. Struct.*, **46**(6), 793. https://doi.org/10.12989/scs.2023.46.6.793.
Jafari, N. and Azhari, M. (2023), "Nonlinear free vibration analysis of moderately thick viscoelastic plates with various geometrical properties", *Steel Compos. Struct.*, **48**(3), 293-303. https://doi.org/10.12989/scs.2023.48.3.293.
Jansukpum, K. and Kettem, S. (2015), "Applying innovation resistance theory to understand consumer resistance of using online travel in Thailand", *2015 14th International Symposium on Distributed Computing and Applications for Business Engineering and Science (DCABES)*, 139-142. https://doi.org/10.4156/AISS.vol4.issue22.7.
Karalar, M., Ozturk, H. and Ozkilic, Y.O. (2023), "Experimental and numerical investigation on flexural response of reinforced rubberized concrete beams using waste tire rubber", *Steel Compos. Struct.*, **48**(1), 43-57. https://doi.org/10.12989/scs.2023.48.1.043.
Ke, X., Wei, H., Yang, L. and An, J. (2023), "Seismic performance and damage evaluation of concrete-encased CFST composite columns subjected to different loading systems", *Steel Compos. Struct.*, **47**(1), 121. https://doi.org/10.12989/scs.2023.47.1.121.
Khosravikhor, A., Gholhaki, M., Rezaifar, O. and Pachideh, G. (2023), "Effect of Ni-Ti shape memory alloy on ductility and response modification factor of SPSW systems", *Steel Compos. Struct.*, **48**(3), 353. https://doi.org/10.12989/scs.2023.48.3.353.
Kontoni, D.P.N., Ghamari, A. and Thongchom, C. (2023), "Experimental and numerical study of a steel plate-based damper for improving the behavior of concentrically braced frames", *Steel Compos. Struct.*, **47**(2), 185-201. https://doi.org/10.12989/scs.2023.47.2.185.
Kuan, F.Y., Ho, Y.P., Chen, W.I. and Chen, C.W. (2012), "The impact of mood state of information service on purchase intention: A perspective of heuristics", *Adv. Inform. Sci. Serv. Sci.*, **4**(17).
Kuan, F.Y., Ho, Y.P., Lu, Z. and Chen, C.W. (2012), "The Consumers' heuristics effects of E-commerce's price promotion on perceived value", *Adv. Inform. Sci. Serv. Sci.*, **4**(20).
Kuan, F.Y., Ho, Y.P., Wang, R.Y. and Chen, C.W. (2013), "Using RPC Block Adjustment models for the

accuracy of environmental research, cartography and geomarketing: A new concept of cartography", *Stochast. Environ. Res. Risk Assess.*, **27**, 1315-1331. https://doi.org/10.1007/s00477-012-0668-8.
Kuo, H.M., Chen, C.W. and Hsu, C.H. (2009), "A study of information and aiding interface design in B2C web sites", *2009 IEEE International Conference on Industrial Engineering and Engineering Management*, 852-855. https://doi.org/10.1109/IEEM.2009.5372897.
Kuo, H.M. and Chen, C.W. (2011), "Application of quality function deployment to improve the quality of Internet shopping website interface design", *Int. J. Innov. Comput., Inform. Control*, **7**(1), 253-268.
Kuo, H.M. and Chen, C.W. (2012), "Retracted: A novel viewpoint on information and interface design for auction web sites", *Human Fact. Ergonom. Manuf. Serv. Indus.*, **22**(4), 287-295. https://doi.org/10.1002/hfm.20274.
Kuo, H.M., Chen, C.W. and Chen, C.W. (2010), "A behavioral model of the elderly Internet consumer: a case study", *Int. J. Innov. Comput., Inform. Control*, **6**(8), 3507-3518.
Kuo, H.M., Chen, C.W. and Chen, C.W. (2010), "A study of consumer behavior model on auction websites", *ICIC Expr. Lett.*, **4**(1), 65-70.
Kuo, H.M., Chen, C.W. and Chen, C.W. (2011), "A study of merchandise information and interface design on B2C websites", *J. Marine Sci. Technol.*, **19**(1), 3.
Kuo, H.M., Chen, C.W. and Hsu, C.H. (2012), "Retracted: A study of a B2C supporting interface design system for the elderly", *Human Fact. Ergonom. Manuf. Serv. Indus.*, **22**(6), 528-540. https://doi.org/10.1002/hfm.20297.
Kuo, H.M., Chen, C.W., Hsu, C.H. and Chen, C.W. (2010), "An observation of online auction difficulties for customers", *An International Journal of Research and Surveys (ICIC-EL)*, **4**(3).
Lee, W.I., Chen, C.W. and Wu, C.H. (2010), "Relationship between quality of medical treatment and customer satisfaction-a case study in dental clinic association", *Int. J. Innov. Comput., Inform. Control*, **6**(4), 1805-1822.
Lee, W.I., Chen, C.W., Chen, K.H., Chen, T.H. and Liu, C.C. (2012), "A comparative study on the forecast of fresh food sales using logistic regression, moving average and BPNN methods", *J. Marine Sci. Technol.*, **20**(2), 4.
Lee, W.I., Chiu, Y.T.H., Liu, C.C. and Chen, C.W. (2012), "Self-service technologies: A review of extant knowledge and research agenda", *Adv. Inform. Sci. Serv. Sci.*, **4**(20).
Li, G., Hou, C., Shen, L. and Hou, C.C. (2023), "Lateral impact behaviour of concrete-filled steel tubes with localised pitting corrosion", *Steel Compos. Struct.*, **47**(5), 615. https://doi.org/10.12989/scs.2023.47.5.615.
Li, Y.P., She, G.L., Gan, L.L. and Liu, H.B. (2023), "Nonlinear thermal post-buckling analysis of graphene platelets reinforced metal foams plates with initial geometrical imperfection", *Steel Compos. Struct.*, **46**(5), 649. https://doi.org/10.12989/scs.2023.46.5.649.
Lin, C.L., Wang, J.F., Chen, C.Y., Chen, C.W. and Yen, C.W. (2009), "Improving the generalization performance of RBF neural networks using a linear regression technique", *Exp. Syst. Appl.*, **36**(10), 12049-12053. https://doi.org/10.1016/j.eswa.2009.03.012.
Lin, C.W., Chen, C.W., Hsu, W.K., Chen, C.Y., Tsai, C.H., Hung, Y.P. and Chiang, W.L. (2013), "Application of a feature-based approach to debris flow detection by numerical simulation", *Nat. Hazard.*, **67**, 783-796. https://doi.org/10.1007/s11069-013-0605-2.
Lin, C.W., Chen, K.W., Chen, S.C., Chen, C.W. and Hung, Y.P. (2015), "Large-area, multilayered, and high-resolution visual monitoring using a dual-camera system", *ACM Trans. Multimedia Comput., Commun. Appl. (TOMM)*, **11**(2), 1-23. https://doi.org/10.1145/2645862.
Lin, C.W., Hung, Y.P., Hsu, W.K., Chiang, W.L. and Chen, C.W. (2013), "The construction of a high-resolution visual monitoring for hazard analysis", *Nat. Hazard.*, **65**, 1285-1292. https://doi.org/10.1007/s11069-012-0409-9.
Lin, J.W., Chen, C.W. and Chung, S.H. (2012), "Modeling and assessment of bridge structure for seismic hazard prevention", *Nat. Hazard.*, **61**, 1115-1126. https://doi.org/10.1007/s11069-011-9969-3.
Lin, J.W., Chen, C.W. and Hsu, T.C. (2012), "Fuzzy statistical refinement for the forecasting of tenders for roadway construction", *J. Marine Sci. Technol.*, **20**(4), 9. https://doi.org/10.6119/JMST-011-0318-1.
Lin, J.W., Chen, C.W. and Hsu, T.C. (2013), "A novel regression prediction model for structural engineering

applications", *Struct. Eng. Mech.*, **45**(5), 693-702. https://doi.org/10.12989/sem.2013.45.5.693.
Lin, J.W., Chen, C.W. and Peng, C.Y. (2012), "Kalman filter decision systems for debris flow hazard assessment", *Nat. Hazard.*, **60**, 1255-1266. https://doi.org/10.1007/s11069-011-9907-4.
Lin, J.W., Chen, C.W. and Peng, C.Y. (2012), "Potential hazard analysis and risk assessment of debris flow by fuzzy modeling", *Nat. Hazard.*, **64**, 273-282. https://doi.org/10.1007/s11069-012-0236-z.
Lin, M.L. and Chen, C.W. (2010), "Application of fuzzy models for the monitoring of ecologically sensitive ecosystems in a dynamic semi-arid landscape from satellite imagery", *Eng. Comput.*, **27**(1), 5-19. https://doi.org/10.1108/02644401011008504.
Lin, M.L. and Chen, C.W. (2011), "Using GIS-based spatial geocomputation from remotely sensed data for drought risk-sensitive assessment", *Int. J. Innov. Comput., Inform. Control*, **7**(2), 657-668.
Lin, M.L., Cao, Y., Juan, C.H., Chen, C.W., Hsueh, I.C., Wang, Q.B. and Lee, Y.T. (2008), "Monitoring drought dynamics in the ejin oasis using drought indices from modis data", *IGARSS 2008-2008 IEEE International Geoscience and Remote Sensing Symposium*, **4**, IV-834.
Lin, M.L., Chen, C.W., Shih, J.Y., Lee, Y.T., Tsai, C.H., Hu, Y.T., ... & Wang, C.Y. (2009), "Using MODIS-based vegetation and moisture indices for oasis landscape monitoring in an arid environment", *2009 IEEE International Geoscience and Remote Sensing Symposium*, **4**, IV-338. https://doi.org/10.1109/IGARSS.2009.5417382.
Lin, M.L., Chen, C.W., Wang, Q.B., Cao, Y., Shih, J.Y., Lee, Y.T., ... & Wang, S. (2009), "Fuzzy model-based assessment and monitoring of desertification using MODIS satellite imagery", *Eng. Comput.*, **26**(7), 745-760. https://doi.org/10.1108/02644400910985152.
Lin, M.L., Chu, C.M., Chen, C.W., Cao, Y., Shih, J.Y., Lee, Y.T. and Ho, L.D. (2008), "A gis-based local spatial autocorrelation for drought risk assessment in arid and semi-arid environments: a case study in Ejin oasis, western China", *IGARSS 2008-2008 IEEE International Geoscience and Remote Sensing Symposium*, **4**, IV-830. https://doi.org/10.1109/IGARSS.2008.4779851.
Lin, M.L., Sun, F., Wang, Q., Chen, C.W., Shiu, Y.S. and Chu, T.H. (2011), "Spatial filtering analysis for quick drought assessment using MODIS images to detect drought affected areas", *2011 IEEE International Geoscience and Remote Sensing Symposium*, 767-770. https://doi.org/10.1109/IGARSS.2011.6049243.
Lin, S.G., Tseng, C.P., Chiang, W.L., Tsai, C.H. and Chen, C.W. (2006), "Modelling ionospheric effects with multiple reference stations for gps satellite surveying", *Proceedings of the 17th IASTED International Conference on Modelling and Simulation*, ACTA PRESS ANAHEIM, Anaheim, 68-73.
Liu, C.C., Chen, Y.Y. and Chen, C.W. (2013), "Application of multi-scale remote sensing imagery to detection and hazard analysis", *Nat. Hazard.*, **65**, 2241-2252. https://doi.org/10.1007/s11069-012-0472-2.
Liu, C.C., Kuo, Y.C. and Chen, C.W. (2013), "Emergency responses to natural disasters using Formosat-2 high-spatiotemporal-resolution imagery: forest fires", *Nat. Hazard.*, **66**, 1037-1057. https://doi.org/10.1007/s11069-012-0535-4.
Liu, J. and Qiu, C. (2023), "Cyclic behavior of self-centering braces utilizing energy absorbing steel plate clusters", *Steel Compos. Struct.*, **47**(4), 523-537. https://doi.org/10.12989/scs.2023.47.4.523.
Liu, K.F.R., Chen, J.S., Liang, H.H., Chen, C.W. and Shen, Y.S. (2010), "combining fuzzy logic and data miningto predict the result of an EIA review", *Int. J. Environ. Ecolog. Eng.*, **4**(12), 628-632.
Liu, K.F.R., Chen, C.W. and Shen, Y.S. (2013), "Using Bayesian belief networks to support health risk assessment for sewer workers", *Int. J. Environ. Sci. Technol.*, **10**, 385-394. https://doi.org/10.1007/s13762-012-0136-5.
Liu, K.F.R., Hsu, C.Y., Yeh, K. and Chen, C.W. (2011), "Hierarchical analytic network process and its application in environmental impact evaluation", *Civil Eng. Environ. Syst.*, **28**(1), 1-18. https://doi.org/10.1080/10286600903215078.
Liu, K.F.R., Ko, C.Y., Fan, C. and Chen, C.W. (2012), "Combining risk assessment, life cycle assessment, and multi-criteria decision analysis to estimate environmental aspects in environmental management system", *Int. J. Life Cycle Assess.*, **17**, 845-862. https://doi.org/10.1007/s11367-012-0407-x.
Liu, K.F.R., Ko, C.Y., Fan, C. and Chen, C.W. (2013), "Incorporating the LCIA concept into fuzzy risk assessment as a tool for environmental impact assessment", *Stochast. Environ. Res. Risk Assess.*, **27**, 849-

866. https://doi.org/10.1007/s00477-012-0621-x.

Liu, K.F.R., Kuo, J.Y., Yeh, K., Chen, C.W., Liang, H.H. and Sun, Y.H. (2015), "Using fuzzy logic to generate conditional probabilities in Bayesian belief networks: A case study of ecological assessment", *Int. J. Environ. Sci. Technol.*, **12**, 871-884. https://doi.org/10.1007/s13762-013-0459-x.

Liu, K.F.R., Liang, H.H., Chen, C.W., Chen, J.S. and Shen, Y.S. (2012), "Combining scientific facts and significance criteria to predict the result of an environmental impact assessment review", *J. Environ. Inform.*, **19**(2). https://doi.org/10.3808/jei.201200212.

Liu, K.F.R., Liang, H.H., Yeh, K. and Chen, C.W. (2009), "A qualitative decision support for environmental impact assessment using fuzzy logic", *J. Environ. Inform.*, **13**(2). https://doi.org/10.3808/jei.200900144.

Liu, K.F.R., Lu, C.F., Chen, C.W. and Shen, Y.S. (2012), "Applying Bayesian belief networks to health risk assessment", *Stochast. Environ. Res. Risk Assess.*, **26**, 451-465. https://doi.org/10.1007/s00477-011-0470-z.

Liu, K.F.R., Yeh, K., Chen, C.W. and Liang, H.H. (2011), "Health Risk Assessment for Sewer Workers using Bayesian Belief Networks", *Int. J. Med. Hlth. Sci.*, **5**(9), 383-387.

Liu, M., Bi, S., Shao, S. and Babaei, H. (2023), "Nonlinear vibration of FG-CNTRC curved pipes with temperature-dependent properties", *Steel Compos. Struct.*, **46**(4), 553. https://doi.org/10.12989/scs.2023.46.4.553.

Liu, S., Li, J., Aghajanirefah, H., Khishe, M., Khishe, A., Mahmoodzadeh, A. and Ibrahim, B.F. (2023), "Reinforced concrete structures with damped seismic buckling-restrained bracing optimization using multi-objective evolutionary niching ChOA", *Steel Compos. Struct.*, **47**(2), 147. https://doi.org/10.12989/scs.2023.47.2.147.

Lu, L.T., Chiang, W.L., Tang, J.P., Liu, M.Y. and Chen, C.W. (2003), "Active control for a benchmark building under wind excitations", *J. Wind Eng. Indus. Aerodyn.*, **91**(4), 469-493. https://doi.org/10.1016/S0167-6105(02)00431-2.

Lv, H., Liu, F., Gao, X., Zhou, T. and Yuan, X. (2023), "Influence of loading and unloading of hydraulic support on the caving property of top coal", *Steel Compos. Struct.*, **48**(1), 103-111. https://doi.org/10.12989/scs.2023.48.1.103.

Lyu, J., Zhu, E., Li, R., Sun, B. and Wang, Z. (2023), "Study on the fire resistance of castellated composite beams with ortho hexagonal holes and different beam-end constraints", *Steel Compos. Struct.*, **46**(4), 539. https://doi.org/10.12989/scs.2023.46.4.539.

Lyu, Y.F., Li, G.Q., Cao, K., Zhai, S.Y., Kong, D.Y., Xue, X.Y. and Li, H. (2023), "Lateral stiffness of corner-supported steel modular frame with splice connection", *Steel Compos. Struct.*, **48**(3), 321. https://doi.org/10.12989/scs.2023.48.3.321.

Lyu, Y.F., Li, G.Q., Cao, K., Zhai, S.Y., Kong, D.Y., Xue, X.Y. and Li, H. (2023), "Lateral stiffness of corner-supported steel modular frame with splice connection", *Steel Compos. Struct.*, **48**(3), 321. https://doi.org/10.12989/scs.2023.48.3.321.

Mahmoud, S.R., Ghandourah, E.I., Algarni, A.H., Balubaid, M.A., Tounsi, A., Tounsi, A. and Bourada, F. (2023), "Stability investigation of symmetrically porous advanced composites plates via a novel hyperbolic RPT br", *Steel Compos. Struct.*, **46**(4), 471-483. https://doi.org/10.12989/scs.2023.46.4.471.

Mohamed, N., Mohamed, S.A., Abdelrhmaan, A.A. and Eltaher, M.A. (2023), "Nonlinear stability of bio-inspired composite beams with higher order shear theory", *Steel Compos. Struct.*, **46**(6), 759. https://doi.org/10.12989/scs.2023.46.6.759.

Mou, B., Zhang, A. and Pan, W. (2023), "Unequal depth beam to column connection joint", *Steel Compos. Struct.*, **46**(6), 823. https://doi.org/10.12989/scs.2023.46.6.823.

Nguyen, M.N., Jung, W., Shin, S., Kang, J. and Lee, D. (2023), "Topology optimization of Reissner-Mindlin plates using multi-material discrete shear gap method", *Steel Compos. Struct.*, **47**(3), 365-374. https://doi.org/10.12989/scs.2023.47.3.365.

Noureldin, M., Gharagoz, M.M. and Kim, J. (2023), "Seismic retrofit of steel structures with re-centering friction devices using genetic algorithm and artificial neural network", *Steel Compos. Struct.*, **47**(2), 167-184. https://doi.org/10.12989/scs.2023.47.2.167.

Pakizeh, M.R., Parastesh, H., Hajirasouliha, I. and Farahbod, F. (2023), "Seismic performance of CFS shear wall systems filled with polystyrene lightweight concrete: Experimental investigation and design

methodology", *Steel Compos. Struct.*, **46**(4), 497. https://doi.org/10.12989/scs.2023.46.4.497.
Pham, V.T., Son, H.S., Kim, C.H., Jang, Y. and Kim, S.E. (2023), "A novel method for vehicle load detection in cable-stayed bridge using graph neural network", *Steel Compos. Struct.*, **46**(6), 731. https://doi.org/10.12989/scs.2023.46.6.731.
Prates, L.M.S., Ferreira, F.P.V., Rossi, A. and Martins, C.H. (2023), "Modelling headed stud shear connectors of steel-concrete pushout tests with PCHCS and concrete topping", *Steel Compos. Struct.*, **46**(4), 451. https://doi.org/10.12989/scs.2023.46.4.451.
Qiao, W., Wang, Y., Li, R., Wang, D. and Zhang, H. (2023), "Research on axial bearing capacity of cold-formed thin-walled steel built-up column with 12-limb-section", *Steel Compos. Struct.*, **47**(3), 437. https://doi.org/10.12989/scs.2023.47.3.437.
Qin, X. and Yang, G. (2023), "Hysteretic model for stud connection in composite structures", *Steel Compos. Struct.*, **47**(5), 587. https://doi.org/10.12989/scs.2023.47.5.587.
Rahmdel, J.M. and Shafei, E. (2023), "Strain interaction of steel stirrup and EB-FRP web strip in shear-strengthened semi-deep concrete beams", *Steel Compos. Struct.*, **47**(3), 383. https://doi.org/10.12989/scs.2023.47.3.383.
Rasti, S., Showkati, H., Aghbashi, B.M., Ozani, S.N. and Zirakian, T. (2023), "Experimental behavior assessment of short, randomly-oriented glass-fiber composite pipes", *Steel Compos. Struct.*, **47**(6), 679-691. https://doi.org/10.12989/scs.2023.47.6.679.
Setiawan, G.H. and Suryawan, I.K.D. (2020), "Analisis Kinerja Aplikasi Pengamatan Kondisi Lalu Lintas Berdasarkan Tingkat Akurasi", Seminar Nasional Teknologi Komputer & Sains (SAINTEKS), **1**(1), 579-583. https://doi.org/10.4156/aiss.vol3.issue6.6.
Shen, C.W., Cheng, M.J., Chen, C.W., Tsai, F.M. and Cheng, Y.C. (2011), "A fuzzy AHP-based fault diagnosis for semiconductor lithography process", *Int. J. Innov. Comput., Inform. Control*, **7**(2), 805-816.
Shih, B.Y., Chen, C.W., Chen, C.Y. and Kuo, J.W. (2012), "A robust license plate recognition methodology by applying hybrid artificial techniques", *Int. J. Innov. Comput., Inform. Control*, **8**(10A), 6777-6785.
Shih, B.Y., Chen, C.W., Chen, C.Y. and Lo, T.W. (2012), "Merged search algorithms for radio frequency identification anticollision", *Math. Prob. Eng.*, **2012**, Article ID 609035. https://doi.org/10.1155/2012/609035.
Shih, B.Y., Chen, C.Y., Kuo, J.W., Chen, P.W., Chen, T.H., Chen, C.W., ... & Lee, W.I. (2010,), "A preliminary study on design and development of template-based for license plate recognition system applying artificial coordinates auxiliary techniques", *2010 IEEE International Conference on Industrial Engineering and Engineering Management*, 80-83. https://doi.org/10.1109/IEEM.2010.5674430.
Shih, B.Y., Liang, Y.D., Chen, C.Y. and Chen, C.W. (2012), "NXT information and control on test dimensionality using Kolb's innovative learning cycle", *2012 International Symposium on Information Technologies in Medicine and Education*, **1**, 194-198. https://doi.org/10.1109/ITiME.2012.6291279.
Song, C., Shi, J., Albaijan, I., Elhosiny Ali, H. and Behshad, A. (2023), "Application of computer methods for the effects of nanoparticles on the frequency of the concrete beams experimentally and numerically", *Steel Compos. Struct.*, **48**(1), 19-25. https://doi.org/10.12989/scs.2023.48.1.019.
Su, D.T., Lo, D.C., Chen, C.W. and Huang, Y.C. (2013), "The integration of nautical charts to reconstruct 3D harbor area models and apply assisted navigation", *Nat. Hazard.*, **66**, 1135-1151. https://doi.org/10.1007/s11069-012-0516-7.
Su, R., Li, X. and Li, Z. (2023), "Axial behavior of square CFST encased seawater sea-sand concrete filled PVC/GFRP tube columns", *Steel Compos. Struct.*, **47**(6), 781. https://doi.org/10.12989/scs.2023.47.6.781.
Su, T.J., Cheng, J.C., Huang, M.Y., Lin, T.H. and Chen, C.W. (2011), "Applications of cellular neural networks to noise cancelation in gray images based on adaptive particle-swarm optimization", *Circuit., Syst. Signal Pr.*, **30**, 1131-1148. https://doi.org/10.1007/s00034-011-9269-x.
Sui, L., Wu, H., Tao, M., Jia, Z. and Zhou, T. (2023), "Seismic performance evaluation of steel moment frames with self-centering energy-dissipating coupled wall panels", *Steel Compos. Struct.*, **47**(5), 663-677. https://doi.org/10.12989/scs.2023.47.5.663.
Tagrara, S.H., Saleh, M.M.S., Ghazwani, M.H., Chikh, A., Bousahla, A.A., Kaci, A., ... & Tounsi, A. (2023), "Mechanical and thermal stability investigation of functionally graded plates resting on visco-Pasternak

foundation", *Steel Compos. Struct.*, **46**(6), 839. https://doi.org/10.12989/scs.2023.46.6.839.
Taheri-Behrooz, F. and Torabia, M. (2023), "Low-velocity impact performance of the carbon/epoxy plates exposed to the cyclic temperature", *Steel Compos. Struct.*, **48**(3), 305. https://doi.org/10.12989/scs.2023.48.3.305.
Tan, Z., Zhong, W.H., Meng, B., Duan, S.C., Wang, H.C., Yao, X.Y. and Zheng, Y.H. (2023), "A novel design method for improving collapse resistances of multi-story steel frames with unequal spans using steel braces", *Steel Compos. Struct.*, **47**(2), 253. https://doi.org/10.12989/scs.2023.47.2.253.
Tharwan, M.Y., Daikh, A.A., Assie, A.E., Alnujaie, A. and Eltaher, M.A. (2023), "Refined quasi-3D shear deformation theory for buckling analysis of functionally graded curved nanobeam rested on Winkler/Pasternak/Kerr foundation", *Mech. Bas. Des. Struct. Mach.*, 1-24. https://doi.org/10.12989/scs.2023.47.5.633.
Tsai, C.H. and Chen, C.W. (2010), "An earthquake disaster management mechanism based on risk assessment information for the tourism industry-a case study from the island of Taiwan", *Tour. Manage.*, **31**(4), 470-481. https://doi.org/10.1016/j.tourman.2009.05.008.
Tsai, C.H. and Chen, C.W. (2011), "Development of a mechanism for typhoon-and flood-risk assessment and disaster management in the hotel industry–A case study of the Hualien area", *Scandinav. J. Hospital. Tourism*, **11**(3), 324-341. https://doi.org/10.1080/15022250.2011.601929.
Tsai, C.H. and Chen, C.W. (2011), "The establishment of a rapid natural disaster risk assessment model for the tourism industry", *Tour. Manage.*, **32**(1), 158-171. https://doi.org/10.1016/j.tourman.2010.05.015.
Tsai, C.H., Chen, C.W., Chiang, W.L. and Lin, M.L. (2008), "Application of geographic information system to the allocation of disaster shelters via fuzzy models", *Eng. Comput.*, **25**(1), 86-100. https://doi.org/10.1108/02644400810841431.
Tsai, C.H., Huang, P.H., Chou, W.C., Shih, C.H., Chen, C.Y., Shih, B.Y., ... & Chung, P.Y. (2010), "Sonar-based obstacle avoidance using a path correction method for autonomous control of a biped robot for the learning stratification and performance", *2010 IEEE International Conference on Industrial Engineering and Engineering Management*, 532-536. https://doi.org/10.1109/IEEM.2010.5674501.
Tsai, P.W. and Chen, C.W. (2014), "A novel criterion for nonlinear time-delay systems using LMI fuzzy Lyapunov method", *Appl. Soft Comput.*, **25**, 461-472. https://doi.org/10.1016/j.asoc.2014.08.045.
Tsai, P.W., Alsaedi, A., Hayat, T. and Chen, C.W. (2016), "A novel control algorithm for interaction between surface waves and a permeable floating structure", *China Ocean Eng.*, **30**, 161-176. https://doi.org/10.1007/s13344-016-0009-7.
Tseng, C.P. and Chen, C.W. (2012), "Natural disaster management mechanisms for probabilistic earthquake loss", *Nat. Hazard.*, **60**, 1055-1063. https://doi.org/10.1007/s11069-011-9889-2.
Tseng, C.P., Chang, M.L. and Chen, C.W. (2012), "Retracted: Human factors of knowledge sharing intention among taiwanese enterprises: A preliminary study", *Human Factor. Ergonom. Manuf. Serv. Indus.*, **22**(4), 328-339. https://doi.org/10.1002/hfm.20507.
Tseng, C.P., Chen, C.W. and Tu, Y.P. (2011), "A new viewpoint on risk control decision models for natural disasters", *Nat. Hazard.*, **59**, 1715-1733. https://doi.org/10.1007/s11069-011-9861-1.
Tseng, C.P., Chen, C.W., Yeh, K. and Chiang, W.L. (2007), "Intelligent financial decision model of natural disasters risk control", *Advanced Intelligent Computing Theories and Applications. With Aspects of Theoretical and Methodological Issues: Third International Conference on Intelligent Computing, ICIC 2007*, Qingdao, China, August. https://doi.org/10.1007/978-3-540-74171-8_6.
Tseng, C.P., Chiang, W.L., Hsu, W.K., Hung, D.M., Tsai, C.H. and Chen, C.W. (2006), "Default risk-based probabilistic decision model on natural disasters risk control", *Proceedings of the 17th IASTED International Conference on Modelling and Simulation*, 219-223.
Tseng, C.P., Chiang, W.L., Hsu, W.K., Lin, S.G., Tsai, C.H., Chen, C.W. and Hung, D.M. (2006), "Optimum arrangement between natural disasters insurance and risk control", *Proceedings of the 17th IASTED International Conference on Modelling and Simulation*, 184-187.
Wei, J., Xie, Z., Zhang, W., Yang, Y., Luo, X. and Chen, B. (2023), "Axial compressed UHPC plate-concrete filled steel tubular composite short columns, Part I: Bearing capacity", *Steel Compos. Struct.*, **47**(3), 405. https://doi.org/10.12989/scs.2023.47.3.405.

Wen, C. and Yang, G. (2023), "Stud connection in composite structures: development with concrete age", *Steel Compos. Struct.*, **47**(6), 729-741. https://doi.org/10.12989/scs.2023.47.6.729.
Wu, J., Wei, X. and Luo, X. (2023), "Predicting drying shrinkage of steel reinforced concrete columns with enclosed section steels", *Steel Compos. Struct.*, **47**(4), 539. https://doi.org/10.12989/scs.2023.47.4.539.
Wu, P., Li, D., Yu, F., Fang, Y., Xiang, G. and Li, Z. (2023), "Experimental study on bearing capacity of PFCC column-RC beam joint reinforced with CST", *Steel Compos. Struct.*, **47**(1), 19. https://doi.org/10.12989/scs.2023.47.1.019.
Wu, Y.L. and Chen, C.W. (2013), "Examining the learning experiences of science training among Taiwanese Aboriginal adolescents", *J. Baltic Sci. Edu.*, **12**(3), 312.
Wu, Y.L. and Chen, C.W. (2013), "Examining the micropolitical literacy of science intern teachers in Taiwan", *J. Baltic Sci. Edu.*, **12**(4), 440.
Wu, Y.L., Tsai, Y.L. and Chen, C.W. (2014), "Examining the experiences of career guidance, vocational self-concept, and self-perceived employability among science education majors in Taiwan", *J. Baltic Sci. Edu.*, **13**(2), 182.
Xiamuxi, A., Liu, C. and Jierula, A. (2023), "Study of the longitudinal reinforcement in reinforced concrete-filled steel tube short column subjected to axial loading", *Steel Compos. Struct.*, **47**(6), 709. https://doi.org/10.12989/scs.2023.47.6.709.
Xu, J.Q., She, G.L., Li, Y.P. and Gan, L.L. (2023), "Nonlinear resonances of nonlocal strain gradient nanoplates made of functionally graded materials considering geometric imperfection", *Steel Compos. Struct.*, **47**(6), 795. https://doi.org/10.12989/scs.2023.47.6.795.
Yang, H.C. and Chen, C.W. (2012), "Potential hazard analysis from the viewpoint of flow measurement in large open-channel junctions", *Nat. Hazard.*, **61**, 803-813. https://doi.org/10.1007/s11069-011-0067-3.
Yang, H.C.P. (2013), "Accuracy evaluation of a diagnostic test by detecting outliers and influential observations COE".
Yang, H.C.P., Alex, K.H.C. and Chen, T.H. (2008), "Evaluation of inference adequacy in cumulative logistic regression models: an empirical validation of ISW-ridge relationships", *China Ocean Eng*., **1**, 5.
Yang, H.C.P., Chen, C.Y., Chen, C.W. and Chen, T.H. (2008), "Estimation on internal wave reflection in a two-layer fluid system by cumulative logistic regression model", *J. Marine Sci. Technol.*, **16**(1), 6.
Yaylacı, M., Yaylacı, E.U., Özdemir, M.E., Öztürk, Ş. and Sesli, H. (2023), "Vibration and buckling analyses of FGM beam with edge crack: Finite element and multilayer perceptron methods", *Steel Compos. Struct.*, **46**(4), 565. https://doi.org/10.12989/scs.2023.46.4.565.
Yeh, K. and Chen, C.W. (2010), "Stability analysis of interconnected fuzzy systems using the fuzzy Lyapunov method", *Math. Prob. Eng.*, **2010**, Article ID 734340. https://doi.org/10.1155/2010/734340.
Yeh, K., Chen, C.W. and Chen, C.Y. (2008), "NN robustness design of nonlinear structure systems", *2008 SICE Annual Conference*, 733-736. https://doi.org/10.1109/SICE.2008.4654752.
Yeh, K., Chen, C.W. and Hsiung, T.K. (2007), "Fuzzy control for seismically excited bridges with sliding bearing isolation", *Advanced Intelligent Computing Theories and Applications. With Aspects of Theoretical and Methodological Issues: Third International Conference on Intelligent Computing, ICIC 2007*, Qingdao, China, August. https://doi.org/10.1007/978-3-540-74171-8_47.
Yeh, K., Chen, C.W., Hsieh, C.M., Cheng, Y.C. and Hsu, K.T. (2013), "Fuzzy control for a permeable floating structure", *2013 Third International Conference on Intelligent System Design and Engineering Applications*, 796-799. https://doi.org/10.1109/ISDEA.2012.189.
Yeh, K., Chen, C.W., Lin, S.H. and Chen, C.Y. (2009), "Stability analysis of time-delay fuzzy systems using fuzzy Lyapunov method", *2009 First Asian Conference on Intelligent Information and Database Systems*, 243-248. https://doi.org/10.1109/ACIIDS.2009.85.
Yeh, K., Chen, C.Y. and Chen, C.W. (2008), "Robustness design of time-delay fuzzy systems using fuzzy Lyapunov method", *Appl. Math. Comput.*, **205**(2), 568-577. https://doi.org/10.1016/j.amc.2008.05.104.
Zaoui, F.Z., Ouinas, D., Tounsi, A., Achour, B., Olay, J.A.V. and Butt, T.A. (2023), "Mechanical behaviour analysis of FGM plates on elastic foundation using a new exponential-trigonometric HSDT", *Steel Compos. Struct.*, **47**(5), 551. https://doi.org/10.12989/scs.2023.47.5.551.
Zhan, Y., Huang, W., Zhao, S., Shao, J., Shen, D. and Jin, G. (2023), "Effect of stud corrosion on stiffness in

negative bending moment region of steel-concrete composite beam", *Steel Compos. Struct.*, **48**(1), 59. https://doi.org/10.12989/scs.2023.48.1.059.

Zhang, Y., Zhao, Q., Han, Q. and Bohlooli, N. (2023), "Free vibration analysis of a laminated trapezoidal plate with GrF-PMC core and wavy CNT-reinforced face sheets", *Steel Compos. Struct.*, **48**(3), 275. https://doi.org/10.12989/scs.2023.48.3.275.

Zhao, L., Wang, M., Yang, R., Zhao, M., Song, Z. and Bohlooli, N. (2023), "Using three-dimensional theory of elasticity for vibration analysis of laminated sectorial plates", *Steel Compos. Struct.*, **48**(1), 1-17. https://doi.org/10.12989/scs.2023.48.1.001.

Zou, X., Yan, G., Wu, W., Yang, W., Shi, W. and Sun, Y. (2023), "Effect of thickness stretching and multi-field loading on the results of sandwich piezoelectric/piezomagnetic MEMS", *Steel Compos. Struct.*, **46**(4), 485. https://doi.org/10.12989/scs.2023.46.4.485.

GY