



Behavior of Vehicle Platoon with Limited Output Information Based on Constant Time Heading

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Abstract. This paper presents synchronization of vehicle platoon with limited-output information based on constant time heading spacing policy. Two control schemes, namely neighborhood controller neighborhood observer and neighborhood controller local observer designed based on constant time heading will be applied into a vehicle platoon. These control schemes are applicable for general topologies as long as spanning tree condition is fulfilled. Both control schemes have identical controller part but different approach in the observer parts. Neighborhood controller neighborhood observer utilizes completely neighborhood information in the observer part, while neighborhood controller local observer only uses the internal information in the observer part. The performance of both controllers will be analyzed numerically, and the results will be compared. Furthermore, the behavior of each follower in various vehicle-to-vehicle topologies in responding to disturbance will be presented and some remarks will be summarized.

Keywords: Vehicle Platoon, Constant Time Heading, Neighborhood Controller, Local Observer.

1 Introduction

Solutions to various problems in the field of transportation require various technological approaches from various sides, including the application of technology in road constructions, traffic sign infrastructures, traffic managements and the vehicles themselves. This paper presents one of the possible solutions in terms of vehicle technology which utilizes collaboration between vehicles, called as a vehicle platoon. Vehicle platoon can be defined as a group of vehicles that collaborate to move like a train by utilizing the information exchanged with a certain topology. With a formation like a train, the vehicle at the front will be set as the leader (like a locomotive) and the remaining vehicles as followers (like carriages). In platoon formation, each vehicle will synchronize the distance between vehicles, velocity and acceleration, which usually depends on the movement of the lead vehicle. It is predicted that vehicle platoon will become one of the features of future vehicles that have many benefits such as increasing road capacity, increasing safety, reducing air pollution and saving fuel.

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Currently vehicle platoon is one of the most active research areas because of their promising potential benefits in the future. This research was conducted from various sides, including controller algorithms related to vehicle dynamics and spacing policy [1, 2], sensors and communication technology [3] with various kinds of problems in each side. The development of control schemes on platoons mostly assumes that the information exchanged is under ideal conditions which generally consists of position, velocity and acceleration, as is the case in [2, 4, 5]. In reality, due to sensor limitations only partial information can be obtained by the vehicle. In this condition, usually full-state information will be estimated from the existing information, as is the case in the control scheme proposed by [6, 7]. Two control schemes in [6] have been studied by Prayitno et. al. in [8] to be applied to a vehicle platoon that apply a constant spacing policy. Where the characteristics of the vehicle platoon on several directed topologies have been presented. Some control schemes, such as [9, 10, 11], are also have possibility to be implemented for vehicle platoon applications with various topologies.

In term of spacing policies, there are several spacing policies that can be applied in platoon applications, including constant spacing policy (CSP) on [2, 5], constant time heading (CTH) on [1], and delay-based spacing (DBS) policy on [12] with various advantages and disadvantages. CSP has the advantage in its ability to maximize road capacity with the distance between vehicles as close as possible but has the potential to cause instability of the string when a disturbance occurs [13]. Meanwhile, CTH has advantages in string stability and increasing safety but the distance between vehicles will widen at high speeds which is contradictory to maximizing road capacity [13]. DBS has the advantage of being more realistic by tracking the same velocity profile in the spatial domain, especially when driving in mountainous areas with up and down road contours [12].

The spacing policy is interesting to observe, especially the behavior of each follower vehicle in various topologies. This information is very important for the controller designer in determining which spacing policy and topology are appropriate for the platoon application. The behavior of CSP in various directed topologies has been studied in [8]. Therefore, this paper modifies the control schemes in [8] to be applied based on constant time heading for synchronization of vehicle platoon. There are two control schemes studied here, namely the neighborhood controller neighborhood observer and the neighborhood controller local observer which will be applied to each follower with various topologies. Both of these control schemes have similarities in the controller but are different from the observer side.

The contribution of this paper is in the formulation of constant time headings that can be applied to vehicle platoon with limited output information under various topologies. Moreover, information about the behavior of each follower vehicle in various applied topologies will be summarized. This information is very useful for understanding the characteristics of constant time heading in vehicle platoon applications.

2 System Description

Homogeneous vehicle platoon that consists of one leader and N-followers usually described by the following dynamics,

$$\begin{cases} \dot{x}_i = Ax_i + Bu_i, \\ y_i = Cx_i. \end{cases} \quad (1)$$

Here, the leader is assigned with $i = 0$ and assumed to have constant velocity or the value of $u_0 = 0$. The remaining vehicles are set as followers with $i = \{1, 2, \dots, N\}$. Limited output information is represented by the value of matrix C . Full-state information usually consists of position, velocity and acceleration, represented by $x_i = [p_i, v_i, a_i]^T$. The relation of position, velocity and acceleration are explained by matrices A and B as follows,

$$A_i = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & -\frac{1}{\sigma_i} \end{bmatrix} \text{ and } B_i = \begin{bmatrix} 0 \\ 0 \\ \frac{1}{\sigma_i} \end{bmatrix}, \quad (2)$$

where σ_i is the inertial time lags of the powertrain. Homogeneity of vehicles can be represented by the same values of σ_i which usually represent identical vehicles. Smaller value of σ_i will has faster transient response compared to bigger value of σ_i . Therefore, smaller value of σ_i usually owned by passenger vehicles, while bigger value of σ_i usually owned by heavy-duty vehicles [14].

To form a platoon, it is necessary to exchange information between vehicles according to the topology. Internal information in each vehicle is obtained by using on-board sensors and exchanged to their neighbors by using Vehicle-to-Vehicle (V2V) communication technology. For controller design and stability analysis, information flow in the platoon is usually expressed in terms of adjacency matrix and pinning matrix. The adjacency matrix expresses the information flow between followers and denoted by $\mathcal{A} = [a_{ij}] \in \mathbb{R}^{N \times N}$, where the value of $a_{ij} = 1$, if the information is received by vehicle i from vehicle j , otherwise $a_{ij} = 0$. While, the pinning gain represents the leader's information received by followers which denoted by $\mathcal{P} = \text{diag}\{p_{11}, p_{22}, \dots, p_{NN}\}$, where the value of $p_{ii} = 1$ if the information flow from the leader to follower i , otherwise $p_{ii} = 0$. In the vehicle platoon, the V2V topology is required to contain at least a spanning tree condition, with the leader as the root tree. There are six common V2V topologies in the vehicle platoon, namely predecessor following (PF), predecessor following leader (PFL), two-predecessor following (TPF), two-predecessor following leader (TPFL), Bidirectional (BD) and Bidirectional Leader (BDL).

When the platoon formation is achieved, each vehicle will have synchronous inter-vehicle distance, which can either be CSP or CTH. CSP has advantages in maximizing the road capacity and reducing the fuel cost when applied in heavy-duty vehicle with some conditions. While CTH has shown to be able to maintain the stability of the whole platoon and increase the safety. This paper utilizes CTH spacing policy for the platoon

synchronization. The challenge in this paper is to formulate the desired distance between vehicle i and lead vehicle which applicable to general topology. The desired distance is formulated as,

$$d_{i,0} = i(h \cdot v_i + \ell), \quad (3)$$

where h is constant time heading and ℓ is the standstill of each vehicle. When the platoon formation is formed, each follower will synchronize the velocity and acceleration to the leader and maintain the desired spacing. It means that in platoon formation, the following condition is achieved,

$$\begin{cases} \lim_{t \rightarrow \infty} \|p_i(t) - p_0(t)\| = d_{i,0} \\ \lim_{t \rightarrow \infty} \|v_i(t) - v_0(t)\| = 0 \\ \lim_{t \rightarrow \infty} \|a_i(t) - a_0(t)\| = 0 \end{cases} \quad (4)$$

Another challenge is when each vehicle has limited-output information due to limitation of the onboard sensor. Therefore, the objective of this paper is to design distributed controller for each follower with limited-output information for synchronization of vehicle platoon based on constant time heading. Moreover, this paper will discuss the behavior of each follower in each topology when applying CTH.

3 Distributed Controller

In this paper, two control schemes for vehicle platoon with limited output information will be presented, namely Neighborhood Controller Neighborhood Observer (NCNO) and Neighborhood Controller Local Observer (NCLO). This control schemes are adopted from [6] and will be applied for vehicle platoon with CTH spacing policy and the behavior of each follower in each topology will be summarized.

3.1 Neighborhood Controller Neighborhood Observer (NCNO)

Block diagram of NCNO is shown in Fig. 1. It mainly consists of two parts, namely neighborhood observer (NO) and neighborhood controller (NC). NO has responsibility to estimate the full-state information of the vehicle dynamics. While, NC utilizes the internal and neighbors' states estimation for controller design purposes.

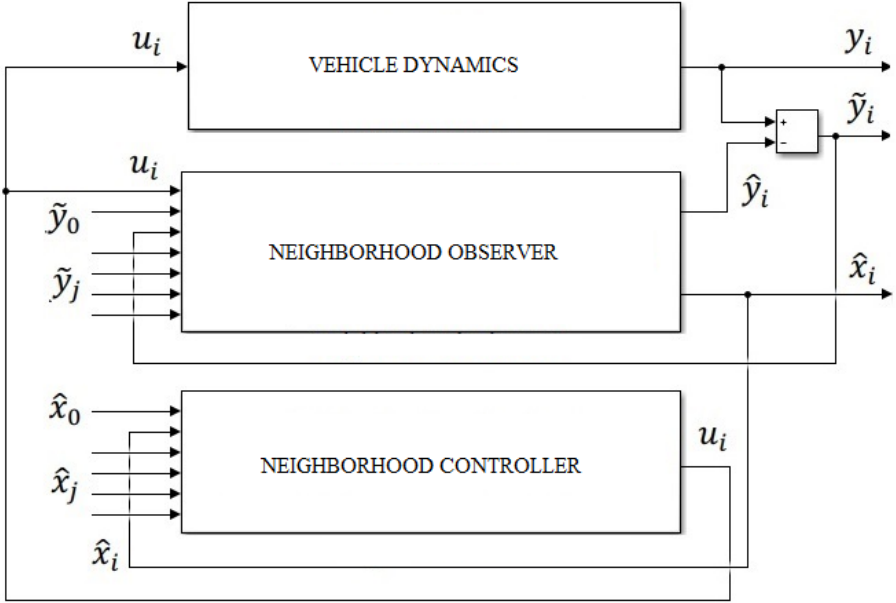


Fig. 1. Block diagram of Neighborhood Controller Neighborhood Observer.

To include CTH spacing policy (3) in the controller design, let define vector $\bar{x}_i = [i(h \cdot v_i + \ell), 0, 0]^T$ and $\hat{\bar{x}}_i = [i(h \cdot \hat{v}_i + \ell), 0, 0]^T$. Let \hat{x}_i be the state observer, i.e. the full-state estimation of x_i , which obtained by,

$$\dot{\hat{x}}_i = A\hat{x}_i + Bu_i - cF\mu_i, \quad (5)$$

where μ_i is the cooperative output estimation error which calculated by utilizing the internal output estimation error, $\tilde{y}_i = C(x_i + \bar{x}_i) - C(\hat{x}_i + \hat{\bar{x}}_i)$, and neighbors' output estimation error, $\tilde{y}_j = C(x_j + \bar{x}_j) - C(\hat{x}_j + \hat{\bar{x}}_j)$ and $\tilde{y}_0 = Cx_0 - C\hat{x}_0$, as follows,

$$\mu_i = \sum_{j=1}^N a_{ij}(\tilde{y}_j - \tilde{y}_i) + g_{ii}(\tilde{y}_0 - \tilde{y}_i). \quad (6)$$

The observer gain, F , can be defined as

$$F = P_2 C^T R^{-1}, \quad (7)$$

where P_2 is the solution of the observer algebraic Riccati equation (ARE), by choosing Q and R positive definite,

$$0 = A^T P_2 + P_2 A + Q - P_2 C^T R^{-1} C P_2, \quad (8)$$

The control signal u_i is designed by utilizing the internal and neighbors' state estimation,

$$u_i = cK \sum_{j=1}^N \{a_{ij}((\hat{x}_j + \bar{\hat{x}}_j) - (\hat{x}_i + \bar{\hat{x}}_i))\} + g_{ii}((\hat{x}_0) - (\hat{x}_i + \bar{\hat{x}}_i)). \quad (9)$$

where $c > 0$ is a coupling gain, $K \in \mathbb{R}^{m \times n}$ is the feedback gain matrix chosen as follows,

$$K = R^{-1}B^T P_1, \quad (10)$$

where P_1 is a solution of the algebraic Riccati equation (ARE),

$$0 = A^T P_1 + P_1 A + Q - P_1 B R^{-1} B^T P_1. \quad (11)$$

3.2 Neighborhood Controller Local Observer (NCLO)

NCLO is a simplification of NCNO. Instead of using completely neighbors' output estimation error, NCLO only using the internal output estimation error to estimate the full-state information of each follower. The block diagram of NCLO is shown in Fig. 2. It consists of two main blocks, namely local observer (LO) and neighborhood controller (NC). In here NC is similar with (9), while local observer is designed as

$$\dot{\hat{x}}_i = A\hat{x}_i + Bu_i - cF\tilde{y}_i. \quad (12)$$

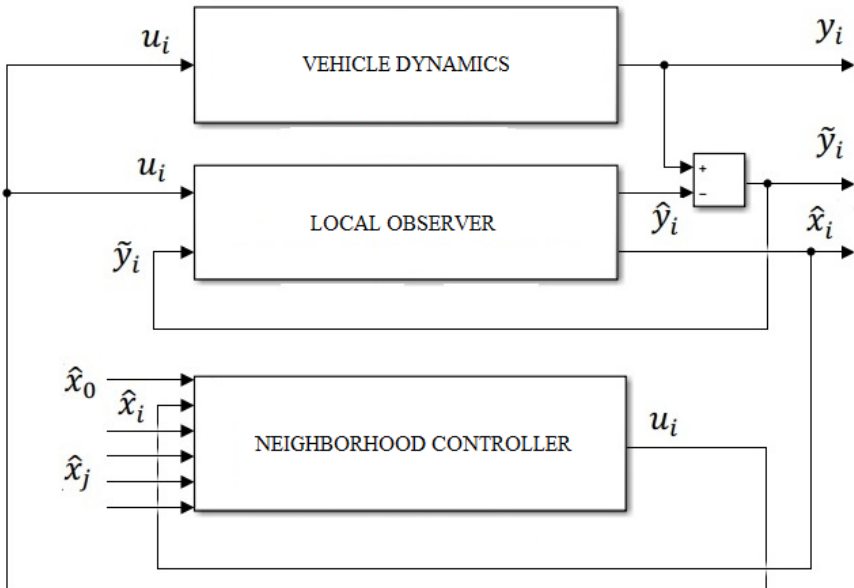


Fig. 2. Block diagram of Neighborhood Controller Local Observer.

4 Numerical Simulation

For numerical simulation, a vehicle platoon consists of 1 leader and 5 followers is used. Vehicles are assumed to be homogeneous with the inertial time lag, $\sigma_i = 0.25$ and only information about position can be obtained. There are two scenarios for the numerical simulation. First, the performance of both control schemes, NCNO and NCLO, when applying CTH spacing policy will be presented. In the first scenario, it is assumed that vehicle platoon applying PF topology and working with coupling gain $c = 0.6$. In the second scenario, the behavior of each follower in many types of V2V topology will be presented. For this purpose, six V2V topologies are studied, namely PF, BD, PFL, BDL, TPF and TPFL, as shown in Fig. 3. To find out the behavior of the followers in responding to disturbances, the lead vehicle is designed to have an input profile as,

$$u_0 = \begin{cases} 0, & 0 \text{ s} \leq t \leq 25 \text{ s} \\ 1, & 25 \text{ s} < t \leq 35 \text{ s} \\ 0, & 35 \text{ s} < t \leq 65 \text{ s} \\ -1, & 65 \text{ s} < t \leq 75 \text{ s} \\ 0, & t > 75 \text{ s} \end{cases} . \quad (12)$$

For CTH spacing policy, $h = 0.2 \text{ s}$ and $\ell = 5 \text{ m}$ are selected. By choosing $R = 0.01$ and $Q = I_{3 \times 3}$, feedback and observer gain matrices are obtained as follow,

$$K = [10.0000 \quad 17.5946 \quad 9.4784]. \quad (13)$$

$$F = [175.9456 \quad 104.7842 \quad 2.5000]^T. \quad (14)$$

Vehicles are set in initial conditions as listed in Table 1.

Table 1. Initial conditions of vehicles.

	Vehicle					
	0	1	2	3	4	5
$p_i(0)$	50	40	30	20	10	0
$v_i(0)$	20	18	18	18	18	18
$a_i(0)$	0	0	0	0	0	0
$\hat{p}_i(0)$	-	40	30	20	10	0
$\hat{v}_i(0)$	-	19	19	19	19	19
$\hat{a}_i(0)$	-	0	0	0	0	0

The performance of NCNO and NCLO when applying CTH under PF topology is shown in Fig. 4. It is seen that both control schemes resulting the similar performance when responding to the disturbance that occurs in the leader's vehicle. It means that instead of using all neighbor's output estimation error information, using internal output estimation error only is enough for estimating the full-state information. It confirms that NCLO scheme simplify NCNO controller algorithm.

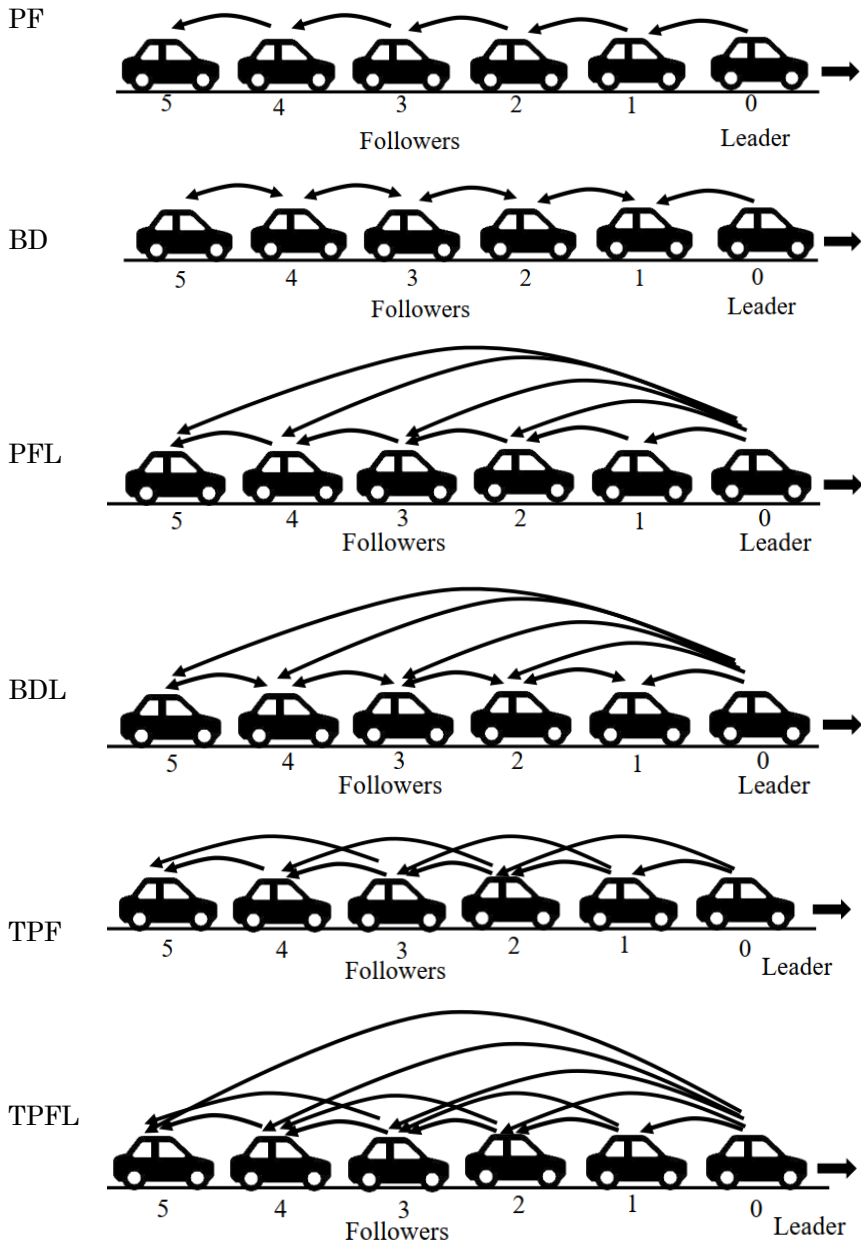


Fig. 3. Six common topologies in vehicle platoon application.

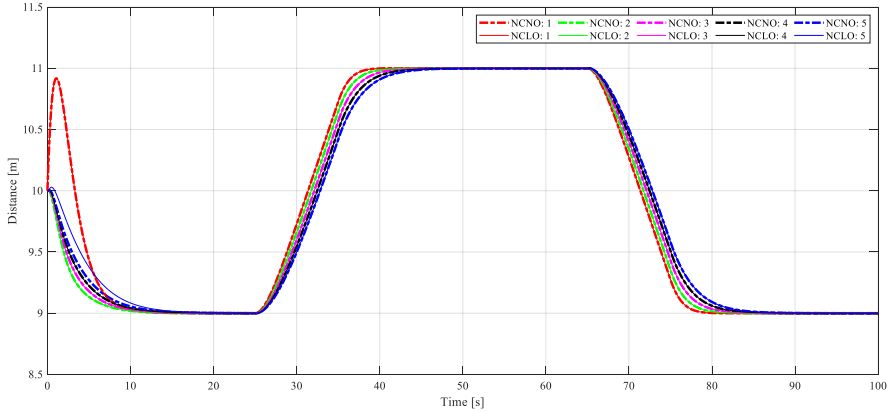


Fig. 4. Performances comparison of NCNO and NCLO.

Due to the satisfactory performance of NCLO, this control scheme will be used to determine the characteristics of the follower in various types of topologies. Simulations were carried out on the 6 topologies mentioned above with the coupling gain values varied from small to large and the response of each follower was observed. For ease of reading, only the four coupling gains are shown in the graph i.e. $c = 0.1$, $c = 0.6$, $c = 10$ and $c = 100$. Simulation results are shown in Fig. 5 to Fig. 9 to represent the behavior of the first follower to the last follower respectively.

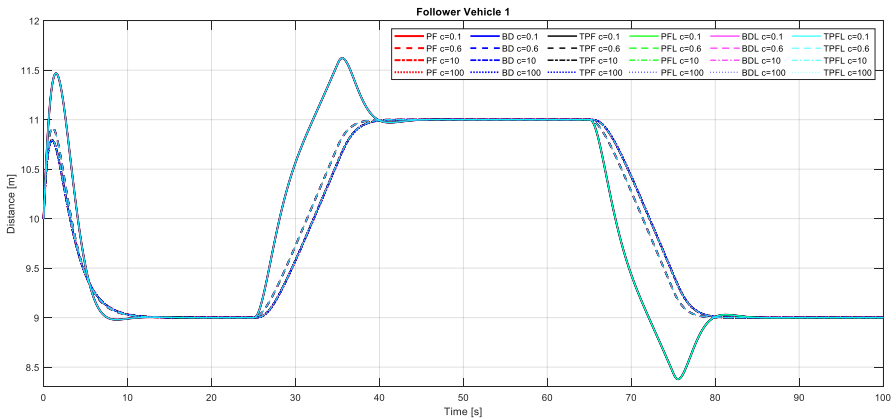


Fig. 5. The first follower’s behavior in some V2V topologies.

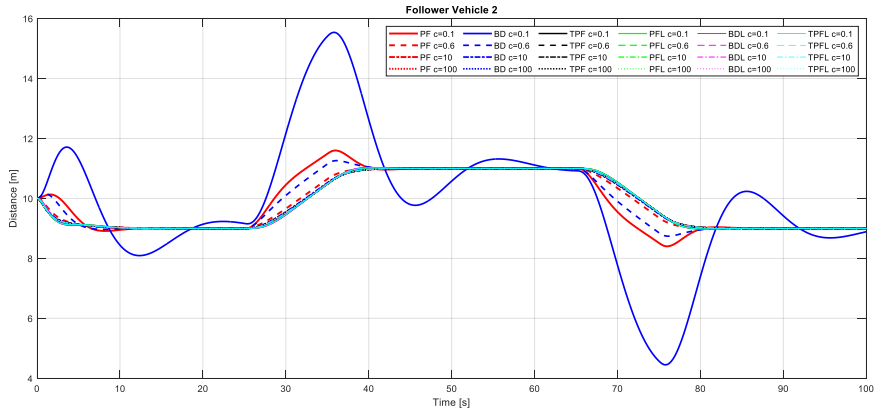


Fig. 6. The second follower’s behavior in some V2V topologies.

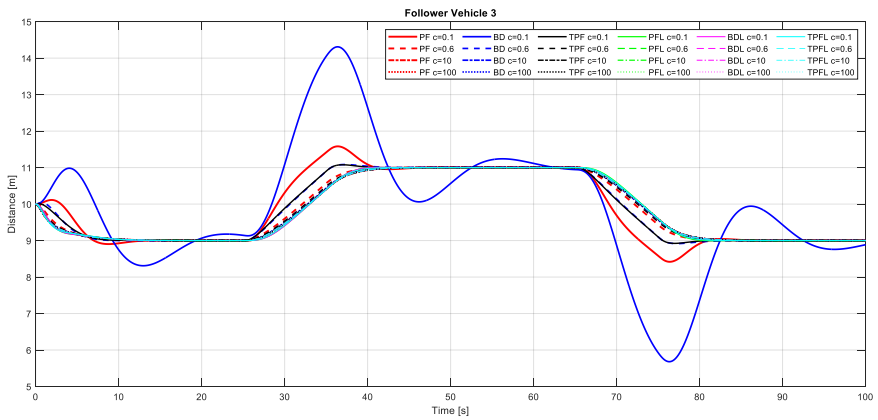


Fig. 7. The third follower’s behavior in some V2V topologies.

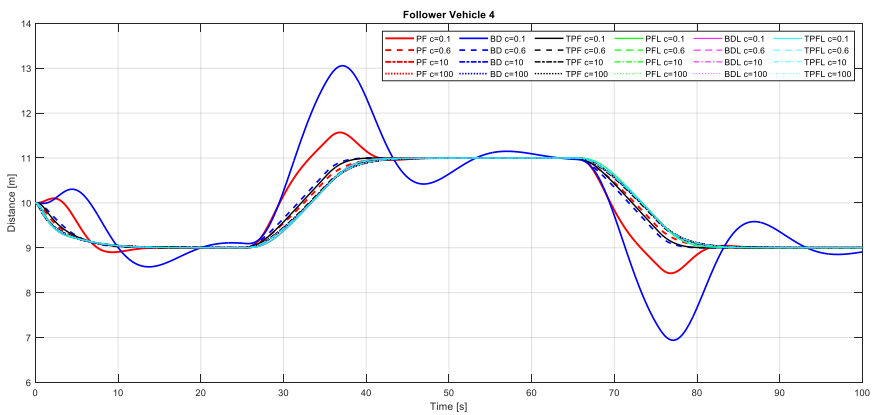


Fig. 8. The fourth follower’s behavior in some V2V topologies.

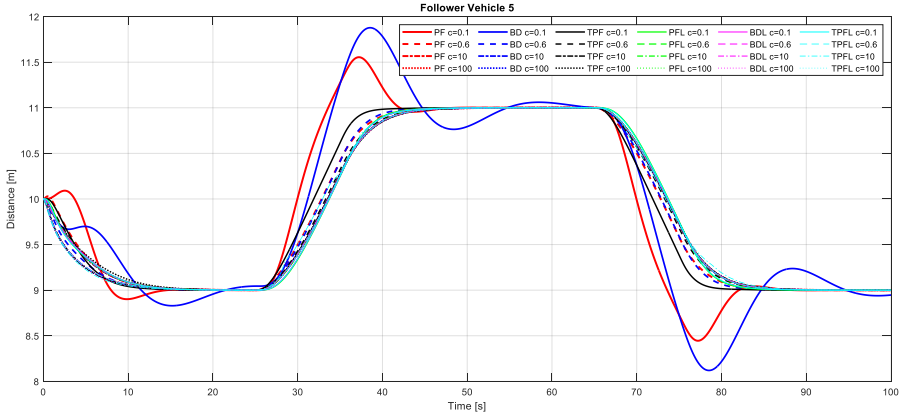


Fig. 9. The fifth follower's behavior in some V2V topologies.

From the simulation results, some remarks can be written here:

- In the first follower it appears that the responses have similar behavior for various topologies for each value of coupling gain. This behavior makes sense because the first follower in all above topologies is only connected to the leader.
- On the remaining followers, vehicles with PFL, TPFL and BDL topologies have relatively the same responses. Meanwhile, vehicles with BD topology have the highest oscillation when disturbance occurs, followed by PF and TPF.
- The greater the coupling gain, the better and the more similar the system responses for all types of topologies.
- With further observations on the control signal, to achieve relatively similar responses for all topologies, it turns out that the control signals required are relatively the same. In BD and PF this can be achieved with a larger coupling gain value compared to TPF, PFL, TPFL and BDL.
- Furthermore, the application of CTH to the NCNO control scheme produces similar characteristics in each follower vehicle.

5 Conclusion

Constant time heading spacing policy has been implemented for two control schemes based on limited-output information, namely NCNO and NCLO. NCNO utilized complete output estimation error from neighbors to obtain the estimated full-state information, while NCLO only used the internal output estimation error. The results showed that NCLO gives similar performance to the NCNO in responding to disturbance. In various topologies, the first follower has similar behavior, while for the remaining followers, vehicles with more complex topologies gave better performance compared to simple topology.

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Bintang Timur Lazuardi, Moses Laksono Singgih

In a fiercely competitive business landscape, every company must optimize its resources and minimize wastage in the production process. At the Pressure Vessel Company (PVC), a study revealed various areas of waste, including non-compliant raw materials, delayed engineering documents, extended production...

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The Application of the Box-Jenkins (BJ) Method for Process Identification of the Batch Milk Cooling System

Rudy Agustriyanto, P. Setyopratomo, E. Srihari Mochni

The Box-Jenkins (BJ) method is a well-known system identification method that has been applied in several fields. Engineers use the Box-Jenkins method for quality control and process optimization in manufacturing. It can identify patterns and trends in production data, leading to improvements in product...

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Performance and Kinetic Study of Xylan Hydrolysis by Free and Immobilized *Trichoderma* Xylanase

Lieke Riadi, Yuana Elly Agustin, Lu Ki Ong, Ferrent Auryn Hadiwijaya, Amelia Winoto, Edrea Adelia Gunawan, Jessica Tambatjong, Tjie Kok

Enzyme immobilization is essential for enhancing the stability and reusability of enzymes in various industrial processes. To improve its feasibility, efficient yet simple immobilization techniques were required to be explored with respect to enhance overall catalytic efficiency and/or operational performance....

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Influence of Inulin and Isomalto-oligosaccharides as Thickener on the Stability of Vitamin C Containing $W_1/O/W_2$ Double Emulsion

Lanny Sapei, Emma Savitri, Hillary Emmanuella Darsono, Yenni Anggraeni

Encapsulation with a $W_1/O/W_2$ double emulsion (DE) system is a method that could protect vitamin C or other active ingredients from external influences thus increasing their stability and bioavailability. The DEs were prepared using hydrogenated coconut oil (HCNO) and middle chain triglycerides (MCT)...

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Effect of the Amount of KIO_3 , Water, and Stirring Time on S Quality in the Iodization Process

Herry Santoso, Febianus F. Setyadi, Maria Lestanur, Kevin C. Wanta, Angel Nadut, Judy R. Witono

Currently, IDD (Iodine Deficiency Disorder) is a problem that still requires attention from the Indonesian government. IDD problems can be overcome by adding iodized salt to daily food. However, the quality of consumption salt produced by small industries in Indonesia is still relatively low in terms...

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Carboxylated Multi-walled Carbon Nanotubes/Calcium Alginate Composite for Methylene Blue Removal

Puguh Setyoprato, Restu Kartiko Widi, Rudy Agustriyanto, Endang Srihari

In this research work, the adsorption of methylene blue (MB) on carboxylated poly-walled nanotubes carbon (PWNC)/calcium alginate composite was studied. The composite was synthesized by the impregnation method. The study was aimed to observe the impact of carbon nanotube dosage on the ability of the...

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Delignification and Characterization of Fiber from Durian Peel Waste

Emma Savitri, Prayogo Widyastoto Waluyo, Leonardus Edward Layantara, Nathasya Fabiola Rusly

The limited availability of natural fiber sources makes durian peel waste an alternative source of natural fiber. The characteristic of durian peel waste,

which is mechanically strength, has the potential to be developed. During durian season, the amount of durian consumption by the community increases...

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Lean and Green Value Stream Mapping: Case Study of an East Java Furniture Factory

Reyhan Iskandar, Moses Laksono Singgih

Research on lean principles in developing countries remains limited, highlighting the need for exploring alternative methods that have a positive environmental impact. One such approach is the utilization of the Value Stream Mapping (VSM) method to develop a system for waste reduction in production processes....

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The Adoption of the Response Surface Methodology within the DMAIC Process to Achieve Optimal Solutions in Reducing Product Defect

Yenny Sari, Amelia Santoso, Nadia Angelina Putri Pangestu

The high number of defective products can cause the company to receive many complaints. This research aimed to apply the quality improvement approach i.e., the DMAIC methodology (Define-Measure-Analysis-Improve-Control), to reduce product defect. The object of discussion was the black-color cloth hangers...

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Behavior of Vehicle Platoon with Limited Output Information Based on Constant Time Heading

Agung Prayitno, Veronica Indrawati, Pyae Pyae Phyo

This paper presents synchronization of vehicle platoon with limited-output information based on constant time heading spacing policy. Two control schemes, namely neighborhood controller neighborhood observer and neighborhood controller local observer designed based on constant time heading will be applied...

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The Interaction Effect of CaCO_3 Composition, Injection Temperature, and Injection Pressure on the Tensile Strength and Hardness of Recycled HDPE

Hendra Prasetyo, Yon Haryono, The Jaya Suteja

The mechanical properties of recycled High-Density Polyethylene (HDPE) are inferior compared to non-recycled HDPE. To overcome this problem, Calcium Carbonate (CaCO_3) is added to improve the material's mechanical properties. The temperature and injection pressure changes can affect the material's mechanical...

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Comparing the Effects of Efficiency and Distortion in Audio Power Amplifiers with and without Tracking Power Supply Circuit Design

Yohanes Gunawan Yusuf, Veronica Indrawati

This research aims to compare the effects of efficiency and distortion in Audio Power Amplifiers with and without Tracking Power Supply (TPS) circuit design. The TPS circuit design is known for enhancing power efficiency while keeping low distortion in the amplifiers. This paper examined the performance...

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Risk Analysis to Mitigate Dominant Risk of Electrical Infrastructure Construction

Salim Afif, Moses Laksono Singgih

Over the past 5 years, the achievement of the Risk Maturity Model (RMM) level value at PT PLN (Persero) UID Bali has not yet reached the target with a gap of 0.47 from the target of 4.19 at the end of 2024. The company's lack of optimization in using the budget period 2018-2023 may be an indicator that...

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Reducing Procurement Waiting Time through Lean Six Sigma

Bagoes Iman Prakoso, Moses Laksono Singgih

A Mass Transportation Manufacturer (MTM) is a pseudonym for the company's name as the subject in this study, faces significant challenges in its procurement process, particularly in acquiring components from foreign

suppliers, which often results in prolonged delays. This delay in procurement has a direct...

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A Model for Evaluating the Impact of Priority Rules on Flow Time and Wait Time In A Job Shop Scheduling System: A Single Machine Case

Muhammad Usman Nisar, Andi Cakravastia Arisaputra Raja, Anas Ma'ruf, Abdul Hakim Halim

In the dynamic realm of job shop scheduling (JSS), where decisions regarding the order of job processing have a significant impact on the initial state and performance of the system, addressing the effects of priority changes becomes crucial. To address this challenge, the first part of the study proposes...

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Modeling and Optimization of Location Selection of Fuel Terminal Considering Vessels and Pipeline Operations

F. Qudsi, R. T. Cahyono, N. F. Sa'idah

This study discusses mathematical modeling using the mixed-integer linear programming (MILP) technique for selecting the optimal fuel terminal location which considers not only aspects of ship and pipeline transportation, but also marine technical aspects. In addition, coverage days are also included...

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Lean Six Sigma and TRIZ to Reduce Non-Value-Added Activities of the Transformer Production Process

Adritho Zaifar, Moses Laksono Singgih

Electronic Transformer Producer (ETP, a nickname) is electronic transformer manufacturing and distribution in Indonesia. The company has encountered challenges in meeting the escalating demands for both quantity and quality from its clientele. Concurrently, the company strives to curtail superfluous...

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Driving Growth in Village Industries: Exploring Effective Financing Facilities for Micro and Small Enterprises

Gunawan

The challenge of financing for micro and small manufacturing enterprises is a global issue but needs local solutions, as the industry characteristics and financing facilities are different among countries and even within countries. In the post-pandemic period, recovering micro and small industries in...

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Remarshaling in A Bin-to-Person-based Smart Automated Warehouse

Ivan Kristianto Singgih, Mai-Ha Phan, Indri Hapsari

In a bin-to-person warehouse, robots lift and then transport racks that contain items from the replenishment area to the storage area and from the storage area to the pickup area. In such an automated warehouse, it is necessary to ensure smooth item flows. One of the important decisions is on which racks...

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Comparison of Classification Machine Learning Models for Production Flow Analysis in a Semiconductor Fab

Ivan Kristianto Singgih, Stefanus Soegiharto, Arida Ferti Syafiandini

A semiconductor fab has complex wafer lot movements between machines and workstations. To ensure a smooth flow of the wafer lots, the system must be observed appropriately. Observation of such a complicated system is possible using machine learning. In this study, various machine learning techniques...

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Circular Economy at LNG Bontang Company: Transforming Aluminum Jacketing Waste Into Sacrificial Anode Products

Defi Willy Simanjuntak, Moses Laksono Singgih

In the industrial activities of the company, one of the crucial considerations and management aspects is waste. At PT. Badak NGL, an existing environmental issue pertains to aluminum jacketing waste. This waste emanates from the factory's operational activities, thereby presenting an opportunity for...

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Restructuring Job Design Using Job Analysis to Balance Workload and Enhance Productivity

Revy Maghriza, Moses Laksono Singgih

One logistics company in Indonesia has experienced a drastic increase of 60% in the demand for imported goods from 2018 to 2022. This upward trend is expected to continue. The admin staff, leader, and supervisor of the Export-Import Department feel the direct impact and are experiencing a higher workload...

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Design of Mid Drive Electric Cargo Bike for Urban Area

Sunardi Tjandra, Susila Candra, Albertus Agung Jody Saputra, Yehezkiel D. Faraisc Putra

Some couriers use bicycles for work. However, it is not efficient because relies on their stamina, which can affect the delivery duration and capacity. E-bike can be a solution to this problem. However, its price is unaffordable for most couriers. It is necessary to modify the couriers' bicycles into...

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The House of Risk with Multi-Actor Approach Aligned with ISO 31000:2018 for Effective Risk Management in Business

with Risky Environment

Evy Herowati, Rosita Meitha Surjani, I Made Panca Bayu Tarsa Ragacca

Effective risk management requires a thorough comprehension of risks and the involvement of multiple actors in the process. In conjunction with the internationally recognized ISO 31000 standard, the House of Risk (HOR) framework provides a robust approach to risk management. This article examines the...

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Centralized AGV Control Systems based on OutsealESP32 PLC and ESP-NOW Protocol

Fransiscus Xaverius Florenza, Hendi Wicaksono Agung

In this paper, a centralized wireless AGV control system is presented using the OE32-PLC board. The OutsealESP32 PLC (O32-PLC) is a combination of the Outseal PLC Mega and the ESP32. Wire-less communication is carried out using the ESP-NOW protocol. The system is divided into three sections according...

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Improving Loading and Unloading Performance at Patimban Port Car Terminal with a Lean Strategy

Yanuar Ardiansyah, Moses Laksono Singgih

Patimban Port located in Subang, West Java, has gained recognition as a National Strategic Project. Its operations, which commenced in December 2020, area primarily designed to optimize the Car Terminal's functionality.

This terminal facilitates the loading and unloading of Completely Built U (CBU)...

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The Influence of Noise Factors on Concentration Based on EEG Signal

Rahmaniyah Dwi Astuti, Rahma Sabilah Nurbi, Bambang Suhardi, Pringgo Widyo Laksono, Irwan Iftadi

The noise intensity with different levels can affect human cognitive abilities, performance, and brain activity. Human cognitive performance, especially concentration, is needed when doing work activities. However, there are still few studies related to the effect of continuous noise in the textile industry...

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Indonesia e-Bike Consumer Preference Trough Market Potential Research: A Choice-Based Conjoint Analysis

Andi Ameera Sayaka Cakravastia, Anas Ma'ruf

E-bike is gaining popularity and accelerating the bike industry to speed up new product development. This study aims to identify e-bike preferences desired by consumers through market research. The choice-based conjoint method analyzes consumer preferences, forecasts potential e-bike market share, and...

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Electric Vehicle Charging Allocation Considering Electricity Price Fluctuation

Ivan Kristianto Singgih, Christian Yavin Ibrahim, Stefanus Soegiharto, Olyvia Novawanda

Charging decisions on electric vehicles is an important aspect to consider for ensuring the continuity of the electric vehicle demand satisfaction. An electric vehicle system could not operate well without sufficient resources for charging each vehicle's battery after its use. In this study, we...

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Overview of Ergonomics and Safety Aspects of Human-Cobot Interaction in the Manufacturing Industry

Muhammad Ragil Suryoputro, Tieling Zhang, Senevi Kiridena

The technological advancements accompanied by Industry 4.0 have created more opportunities for collaborative interactions between humans and machines. In work environments where humans work alongside collaborative robots (i.e., cobots), there is a critical need to address ergonomics and occupational...

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Affective-based Human Factors Design: Design Thinking & Sustainability Approach

Markus Hartono

This paper proposes a refined framework of affect/Kansei-based applied product/service experience considering design thinking and sustainability approaches. Design thinking facilitates more comprehensive step-by-step methodology starting with more human basic needs, followed by the global issues which...

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Performance Evaluation of Roof Tile Solar PV under Tropical Climate of Surabaya, Indonesia

Elieser Tarigan, Fitri Dwi Kartikasari, Fenny Irawati, Rafina Destiarti Ainul, Pradiksa Pratyahara Kirana

This paper discusses the applications of roof tiles type of PV modules. Published researches on this topic were reviewed. In addition, performance evaluation of a roof tile type of PV modules was conducted under the tropical climate of Surabaya, Indonesia. The objectives of present study are to review...

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Pillared Interlayered Clays (PILCs): Harnessing Their Potential as Adsorbents and Catalysts - A Mini Review

Restu Kartiko Widi

The Pillared Interlayered Clays (PILCs) have attracted significant attention in recent years due to their versatile applications as adsorbents and catalysts in various environmental and industrial processes. This mini review presents a comprehensive overview of the recent researches conducted on PILCs...

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Implementation of K-Means and K-Nearest Neighbor Methods for Laptop Recommendation Websites

Vincentius Riandaru Prasetyo, Mohammad Farid Naufal, Budiarjo

Along with technology development, laptops are becoming increasingly popular and are handy tools in everyday life. However, with so many brands and laptops available, people often find it difficult and need help choosing the laptop that best suits their needs and desires. A website-based system has been...

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Implementation of Recency, Frequency, and Monetary Patterns in Adaptive Blockchain-Based Transactions

Daniel Soesanto, Igi Ardiyanto, Teguh Bharata Adji

The development of cryptocurrency cannot be separated from the development of blockchain technology. However, problems arise related to the scalability of the blockchain itself. The long duration of the consensus process means that the scalability of the blockchain cannot increase. Various methods have...

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Electronic Election for Small Medium Non-Profit Organizations in Indonesian Cities

Felix Handani

Elections in Indonesia often include direct voting, enabling every community member to immediately contribute to the election process and support their chosen leader. The digital divide, the security of data and systems, verification and transparency, and the legal and social-cultural acceptance of online...

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Online Claim and Guarantee Mechanism for Electronics Peripheral in Urban Country

Liliana, Felix Handani, Daniel Soesanto, Maya Hilda Lestari Louk

According to consumer protection law, business actors must provide good services, including post-transaction services. Most of the current warranty claim process is still done conventionally, where consumers must come to the store to bring their documents and goods and ask the officer for the repair...

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Perceived Usability Evaluation of IRiS: an Integrated Recommendation Collection System

Jimmy, Kristian Tanuwijaya

This study evaluates the perceived usability of IRiS, which was developed to collect recommendations from senators related to the election of principals in the University of Surabaya (UBAYA). The primary question of this study was "Will IRiS be usable for all senators to use as intended?". The answer...

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Incorporating Interactive Elements into Children's Storybook to Improve Children's Motivation to Learn Bible: Case Study on the Parable of the Sower

Ng Melissa Angga, Tyrza Adelia, Jiechella Davidson

Christian children frequently show low enthusiasm in learning the Bible due to difficulties in understanding the language and unappealing content for their taste. Moreover, their motivation towards Bible studies getting even lower by the exposure to more captivating multimedia products available in this...

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Development of Artificial Immune System in Multi-Objective Vehicle Routing Problem with Time Windows

Iris Martin, Eric Wibisono

Setting logistics routes and product distribution in everyday problems, such as delivery of fresh products, requires an algorithm that can produce decisions in a short time. This type of problem belongs to a methodology popularly known as the vehicle routing problem (VRP). VRP is NP-Hard, and its complexity...

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Has Website Design using Website Builder Fulfilled Usability Aspects? A Study Case of Three Website Builders

Argo Hadi Kusumo

The significance of e-commerce is particularly crucial for businesses. The enhancement of sales can be achieved through the contribution of e-commerce. In the current era of digitalization, it is unnecessary for SMEs to develop e-commerce platforms from scratch. Instead, they can opt for affordable website...

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Design of Employee Bus Routes for Madiun City Government Based on Home Locations and Presence Location History

Daniel Hary Prasetyo, Arizia Aulia Aziiza, Endang Sulistiyani

Madiun City is strategically positioned as the center of regional activities in the western part of East Java Province. Based on the data presented for the City of Madiun in Figures for 2022, the number of residents and private vehicle units is almost the same. Hence, road congestion is likely to occur...

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Arabic Letter Classification Using Convolutional Neural Networks for Learning to Write Quran

Mohammad Farid Naufal, Muhammad Zain Fawwaz Nuruddin Siswantoro, Andre

Learning to write the Arabic language, particularly the Arabic letters used in the Quran, is essential for individuals who aim to understand and recite the holy book accurately. In this research, we propose a classification method

utilizing Convolutional Neural Networks (CNNs) with MobileNet architecture...

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Alveolar Bone Quality Classification from Dental Cone Beam Computed Tomography Images using YOLOv4-tiny

Monica Widiastri, Nanik Suciati, Chastine Fatichah, Eha Renwi Astuti, Ramadhan Hardani Putra, Agus Zainal Arifin

Bone quality is essential in dental implant planning for successful implant placement. Bone quality can be determined based on bone density observed from Beam Computed Tomography (CBCT) images which are commonly used in dental implant planning. The most accepted classification of alveolar bone quality...

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Exploring the Impact of Mobile-Based 3D Simulation on Student's Achievement and Satisfaction in Physics Education

Lisana Lisana, Edwin Pramana

The purpose of this study is to investigate the efficacy of utilizing a mobile-based 3D simulation to support students in the 11th grade in their learning of physics. The precise subject matter that was selected for this piece of research was the equilibrium of rigid bodies. There were 91 students from...

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An Encrypted QR Code Using Layered Numeral Calculation for Low Powered Devices

Rafina Destiarti Ainul, Susilo Wibowo, Irzal Zaini

Providing security system for every electronic data exchange through internet as the unsecured medium has become an essential regulation. Conventional Caesar Cipher had less computation complexity than other security method that really appropriate with low powered device requirement. However, it is susceptible...

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Spices Identification in Essential Oil Producers using Comparasion of KNN and Naïve Bayes Classifier

Fifin Ayu Mufarroha, Achmad Zain Nur, Mohammad Rizal Rahabillah, Achmad Jauhari, Devie Rosa Anamisa, Mulaab

Indonesia is a spice-growing country, providing a variety of spices with numerous health advantages. Aside from being a producer, Indonesia is the world's largest supplier of spices. Spices have a wide range of usage, including food ingredients, herbal medicines, and essential oils. Essential oils are...

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Long Short-Term Memory Method Based on Normalization Data For Forecasting Analysis of Madura Ginger Selling Price

Devie Rosa Anamisa, Fifin Ayu Mufarroha, Achmad Jauhari, Muhammad Yusuf, Bain Khusnul Khotimah, Ahmad Farisul Haq

Forecasting is a method for estimating a future value using past data. The selling price of Madura ginger needs a forecasting analysis to predict future prices because, until now, the selling price has increased significantly. This analysis aims to increase trade business competition and maintain sales...

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Analyzing the Probability Density Distribution of Sustained Phoneme Voice Features in the PC-GITA Dataset for Parkinson's Disease Identification

Nemuel Daniel Pah, Veronica Indrawati, Dinesh K. Kumar, Mohammad A. Motin

One of the possibilities for developing computerized diagnostic tools for Parkinson's disease (PD) is to utilize the voice change known as Parkinsonian dysarthria. Voice features extracted from sustained phonemes have been statistically investigated as parameters for this purpose. However, the commonly...

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Drowsiness Eye Detection using Convolutional Neural Network

Heru Arwoko, Susana Limanto, Endah Asmawati

Eye fatigue while driving can cause drivers to be drowsy and less alert, which can potentially increase the risk of an accident. Existing data shows that the number of accidents in the world is increasing from year to year. One of the most common causes of accidents is fatigue and the leading cause of...

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