IMPROVING PESTICIDE APPLICATION USING MODEL PREDICTIVE CONTROL WITH ACTIVE DEMAND MANAGEMENT FOR PRECISION AGRICULTURE

UMAR ZANGINA

UNIVERSITI TEKNOLOGI MALAYSIA

IMPROVING PESTICIDE APPLICATION USING MODEL PREDICTIVE CONTROL WITH ACTIVE DEMAND MANAGEMENT FOR PRECISION AGRICULTURE

UMAR ZANGINA

A thesis submitted in fulfilment of the
requirements for the award of the degree of
Doctor of Philosophy

School of Electrical Engineering
Faculty of Engineering
Universiti Teknologi Malaysia

OCTOBER 2021

ACKNOWLEDGEMENT

In the name of Allah, the Most Gracious and the Most Merciful. Alhamdulillah, all praises to Allah for the strengths and His unending blessings and mercies in completing this thesis. I would first and foremost like to thank my supervisor, Assoc. Prof. Dr. Salinda Buyamin. She has been a great mentor and guide at every step of my doctoral research. Her passion for research and excellence has been a tremendous source of inspiration for me. Her relentless focus on research problems directly impacting practice has played a great role in shaping my research interests. I feel fortunate on being her student and would like to acknowledge her role in shaping me professionally. I would also like to thank Assoc. Prof. Dr. Shukri Zainal Abidin and Dr. Saiful Azimi Mahmud for mentoring me through tough phases of my doctoral studies, guiding me through roadblocks and helping me negotiate my research. I have learnt a lot from them and they have had a significant impact on my learning process. I would like to say a special thank you to Dr. Naveed Aman, Dr. Sa'id Musa Yarima, Dr Muhammad Aliyu Sulaiman, Dr. Alhassan Umar and Dr. Ibrahim Madugu, for their constructive criticisms, insightful comments and feedback on the general research work, which has helped in shaping this dissertation significantly. I feel privileged to have been a part of the Advanced Control Research Group (ACRG) of the Control and Mechatronics Division at the School of Electrical Engineering, and would like to thank all the wonderful people here, who have contributed towards making my doctoral experience a pleasant one. I would also like to thank all the post graduate students and staff of the division who overlapped with me during my doctoral tenure. Special thanks to Dr. Ibrahim Danmallam, Alh. Ibrahim Sanusi, Engr. Ramadan Nuhu, Alh. Rabiu Aliyu, Dr. Adamu Ya'u and a host of others, for engaging me in several interesting conversations, providing a welcome break from research. Finally, I would like to thank my lovely wife, Asma'u Hamza Abubakar, my lovely children, Fatima Umar Zangina and Ayyad Umar Zangina for their patience, perseverance and most importantly for keeping the faith. Lastly, a special thanks to my brother, Dr. Sulaiman Zangina without whom my entire educational career would not have been possible. His constant moral and financial support were invaluable in helping me deal with the trials and tribulations through the course of my studies.

ABSTRACT

The use of robotics in precision agriculture has significantly improved productivity over the years by automating activities such as spraying, harvesting, and sowing. Without robots, the typical way of applying a fixed amount of pesticide over a specific season or time not only results in economic loss via wasted pesticide but also leads to sub-optimal results in terms of pest control leading to low yield and loss of capital in the agricultural industry. Existing techniques for automating pesticide application only focus on the problem of best route selection for the pesticide spraying robots given a predetermined demand for pest without due consideration to the dynamic and complex nature of the interaction between pests and host plants. Moreover, these techniques either consider simplistic scenarios with only one robot or even if they consider a fleet of vehicles, the proposed solution results in poor coordination among the robots resulting in slow field coverage times as well as higher charge or fuel consumption. To solve these issues, this research introduces the concept of active demand management to the agricultural vehicle routing problem (VRP) along with an efficient solution for vehicle routing using model predictive control (MPC). Demand management is introduced and modelled using the mass-spring damper system along with an estimate of the risk of a pest infestation to obtain a state-space model. Analogous to an electromechanical system, the notion of damping is related to pesticide demand, with an objective to reduce demand. The resulting state-space model is then utilized to solve the agricultural VRP for two cases, a single vehicle and a fleet of vehicles. For the single vehicle case, a discrete-time MPC plant model is used to optimize the delivery of pesticide such that the demand is minimized or in other words to reduce the risk of pests while using a greedy algorithm to efficiently route the vehicle to a specific area in an agricultural field. To solve the problem of pesticide application using a fleet of vehicles, an MPC algorithm is converted into a mixed integer linear programming (MILP) optimization problem. The optimization problem in addition considers the charging and capacity constraints for a set of autonomous vehicles (AV) also considers the evolution of charge and pesticide amount carried by the AVs. This results in an overall solution to autonomous mobility on demand in the agricultural industry. Extensive MATLAB/Simulink simulations show that the proposed technique not only results in significant reduction of up to 80% in terms of field coverage time but also results in a reduction of up to 93% in terms of charge consumption as compared to state of the art existing techniques. The percentage improvement achieved demonstrates the advantage of using MPC.

ABSTRAK

Penggunaan robotik dalam pertanian teliti telah menambah baik pengeluaran dengan automasi penyemburan, penuaian dan penyemaian. Tanpa robot, kaedah menggunakan jumlah racun perosak yang tetap pada musim dan masa yang tertentu bukan sahaja merugikan ekonomi dengan pembaziran racun perosak tetapi, menyebabkan keluaran yang tidak optimum dari segi kawalan perosak yang menjurus kepada pengurangan hasil dan kerugian modal dalam industri pertanian. Teknik-teknik yang sedia ada bagi pengautomatan aplikasi penyemburan racun perosak hanya mencari laluan yang terbaik kepada robot penyembur racun perosak dengan memberikan permintaan yang telah ditentukan terlebih dahulu terhadap perosak, tanpa mengambil kira interaksi antara perosak dan tumbuhan yang dinamik dan kompleks.Teknik-teknik ini hanya mengambil kira senario yang mudah dengan hanya menggunakan sebuah robot atau sekiranya sekumpulan kenderaan diambil kira, penggunaan bahan api yang tinggi. Untuk menyelesaikan isu ini, penyelidikan ini memperkenalkan konsep pengurusan permintaan aktif kepada masalah laluan kenderaan pertanian (VRP) yang efisien untuk laluan kenderaan menggunakan kawalan ramalan model (MPC). Pengurusan permintaan telah diperkenalkan dan dimodelkan menggunakan sistem spring-jisim peredam bersama anggaran risiko serangan makhluk perosak untuk menghasilkan model keadaan-ruang. Serupa dengan sistem elektromekanikal, peredam merujuk kepada permintaan racun perosak dengan objektif untuk mengurangkan permintaan.Model keadaanruang akan digunakan untuk menyelesaikan masalah VRP dalam dua kes, iaitu untuk sebuah kenderaan dan sekumpulan kenderaan. Bagi kes sebuah kenderaan, model MPC masa-diskrit telah digunakan untuk mengoptimumkan penghantaran racun perosak dengan meminimumkan permintaan, dengan erti kata lain mengurangkan risiko makhluk perosak dan algoritma tamak digunakan untuk menghalakan kenderaan ke sesuatu kawasan tertentu dalam kawasan ladang. Untuk menyelesaikan masalah penyemburan racun serangga bagi sekumpulan kenderaan,algoritma MPC telah diubah kepada masalah pengoptimuman pengaturcaraan nombor bulat linear campuran (MILP). Masalah pengoptimuman mengambil kira kekangan pengecasan dan kapasiti bagi sekumpulan kenderaan autonomi (AV) yang juga mengambil kira evolusi pengecasan dan jumlah racun serangga yang dibawa oleh AV. Hal ini menghasilkan penyelesaian yang menyeluruh kepada pergerakan autonomi dalam permintaan industri pertanian. Simulasi meluas menggunakan MATLAB/Simulink telah menunjukkan bahawa teknik yang dicadangkan bukan sahaja menghasilkan pengurangan masa liputan yang signifikan sehingga 80%, malah juga mengurangkan jumlah pengecasan sehingga 93% berbanding dengan teknik-teknik yang sedia ada. Peratus peningkatan yang dicapai menunjukkan kelebihan menggunakan MPC.

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ACO	-	Ant Colony Optimisation
AFO	-	Agricultural field Operation
ASM	-	Active set method
ANN	-	Artificial Neural Network
AV	-	Autonomous Vehicle
CeNMPC	-	Centralized Non-linear Model Predictive Control
CPFR	-	Collaborative Planning Forecasting
CPU	-	Central Processing Unit
CVRP	-	Constrained Vehicle Routing Problem
DC-VRR	-	Support Vector Machine
DeMPC	-	Decentralized Model predictive control
DLQR	-	Discrete-time Linear Quadratic Regulator
DM	-	Demand Management
DMPC	-	Distributed model predictive control
DcMPC	-	Discrete-time Model Predictive Control
FAO	-	Food and Agricultural Organisation
FL	-	Fuzzy logic
FLMPC	-	Feedback Linearization Model Predictive Control
GA	-	Genetic algorithm
GADPP	-	Genetic Algorithm with Dynamic Programming Procedure
GLNPSO	-	Global, local, and near neighbour particle swarm optimization
HDMPC	-	Hierarchical Distribution Model Predictive Control
IPM	-	Interior Point method
LMPC	-	Linear Model Predictive Control

RHC	-	Receding Horizon Control
RMPC	-	Robust model predictive control
RnPC	-	Random Model Predictive Control
SA	-	Simulated Annealing
ScMPC	-	Scenario Model Predictive Control
SHC	-	Shrinking Horizon Control
ScMPC	-	Stochastic model predictive control
SPEA-II	-	Strength Pareto Evolutionary Algorithm
TS	-	Tabu Search
UAV	-	Unmanned Aerial Vehicle
UTM	-	Universiti Teknologi Malaysia
VRP	-	Vehicle Routing Problem
VRPB	-	Vehicle Routing Problem with Backhauls
VRPBTW	-	Vehicle Routing Problem with Backhauls and Time Windows
VRPPD	-	Vehicle Routing Problem with Pickup and Delivery Service
VRPPDBTW	-	Vehicle Routing Problem with Pickup and Delivery Service with backhauls and time window
VRPTW	-	Vehicle Routing Problem with Time Windows

LIST OF SYMBOLS

α	-	Embedding parameter
γ	-	damping coefficient
ϑ	-	vector form of predicted output variable
θ	-	State input variable
ζ	-	Predicted output variable
β	-	Embedding parameter
ϕ	-	anomally
ω	-	disturbance in the demand of pesticide
$\mathcal{I}$	-	Actual inviolability
$\hat{\mathcal{I}}$	-	Forecasted inviolability
v^k	-	Vehicle k
τ^k	-	Time for an Av to reach its Destination
τ_{ij}^k	-	Time for an Av k to move from area i to area j
v_{ij}^k :	-	Vehicle k moving from area i to area j
$\boldsymbol{F}_s$	-	Set-point signal
$\boldsymbol{N}$	-	Horizon
$\boldsymbol{U}$	-	Horizon
$\boldsymbol{N}_c$	-	Control horizon
$\boldsymbol{N}_p$	-	Prediction horizon
$\boldsymbol{y}$	-	Initial displacement
$\boldsymbol{R}$	-	Damping factor
$\boldsymbol{f}(\boldsymbol{t})$	-	input force
$\boldsymbol{y}(\boldsymbol{t})$	-	Damping Coefficient pesticide level
$\boldsymbol{k}_{I}$	-	String constant for Unsprung masses
$\boldsymbol{k}_{\hat{I}}$	-	String constant for sprung masses

CHAPTER 1

INTRODUCTION

1.1 Background

Pests are creatures that cause damage to crops, livestock and forestry, and nuisance to people in farms and homes. Pests include insects, mites, pathogens, weeds, nematodes, and arthropods. Agricultural and horticultural crops are attacked by a variety of pest species. The damage inflicted by pests can be direct crop injury as well as indirect fungal, bacterial or viral infections. With the ever increasing demand for more production, pests are considered a major constraint in crop productivity and profitability around the world. This may lead to an estimated 45 % of pre- and post-harvest losses [2] thereby necessitating the need to improve yield and provide an optimal environment for plant growth. Pesticide application is, therefore, critical to overcome the pest problems. Pesticide, however, can be toxic and hazardous for the environment as well as humans and animals. The traditional approach of applying a fixed amount of pesticide over a specific time leads to problems like wastage of capital, pest resistance and sub-optimal pest management as pests and diseases typically have an uneven spatial and temporal distribution [3,4]. Different species of pests react differently to variations in temperature and rainfall. The particular conditions with a significant impact on pests and crops include extreme temperatures, precipitation level variation and extreme flooding[5]. Thus, the spatiotemporal variability in weather conditions resulting from short- and long-term climate variability could affect water availability, soil conditions, crop yield, and crop vulnerability to pest and pathogen infestations.

The favourable weather conditions that influence pest infestations on farm lands include temperature, wind, rainfall, and relative humidity [6]. Seasonal variability in weather patterns with preceding or dominant impact climate conditions provide not only a favourable environment for the production and distribution of insect species, but also affects crop growth and development, and ultimately the final yield.

The Existing efforts on pest prediction successfully forecast pest infestation according to weather conditions [7, 8]. However, these efforts have only focused on the vehicle routing problem (VRP) without considering the risk of pests by assuming- a pre-determined demand for pesticide application based on the actual pest presence in the agricultural fields. This assumption not only defeats the purpose of precision agriculture but also results in sub-optimal controllers. Thus, it is imperative to apply the optimal amount of pesticide at an optimal time and place. Most of the aforementioned efforts consider the pesticide management problem as VRP, such as optimizing the path taken by vehicles to apply pesticide to an agricultural field given a pre-determined mapping of pests. Moreover, these techniques are based on complex optimization algorithms such as tabu search algorithm [9, 10], fluid search optimization [11], simulated annealing [12], and evolutionary algorithms [13, 14]. The objective of optimal pesticide application is not only to control but also to predict and mitigate the onset of a pest infection given the basic risk factors such as susceptibility of host plants, a virulent pathogen or pest and favourable weather conditions. The aforementioned studies [7, 8] mainly forecast the onset of pests in such a way that optimal and timely pesticide application can be used not only to reduce the damage to plants but also to reduce the amount of pesticide used leading to an overall environmentally friendly and efficient approach. Exploiting the insights gained from these recent studies on predicting a pest infestation based on various risk factors, this research proposes a dynamic model to reduce the risk of pests even before the infestation starts. In particular, an active suspension system is proposed which takes as input not only the pre-determined demand of pests (such as the actual pest situation) but also the risk of a pest infestation at a specific instant of time to optimize the amount of pesticide to be sprayed at a specific location. The existing techniques are only considered the actual pest infestation to determine the optimal amount of pesticide to be sprayed. However, this approach does not reduce the risk of pests but can only control a pest infestation once it occurs.

The interactions between pests and a host plant are considered to be a complex and dynamic system with existing works also showing a significant correlation of weather with the onset of pests [6, 15]. Therefore, the pest forecasting problem gets more complex with the addition of further uncertainty in the form of weather data. The problem of pest management, therefore, requires an interdisciplinary approach that spans prediction, dynamics, optimization and control theory. The objective of optimal pesticide application is to predict and mitigate the onset of a pest infestation given the basic risk factors such as susceptibility of host plants, a virulent pathogen or pest and favourable weather conditions such as temperature, wind, rainfall, and relative humidity [6]. Seasonal variability in weather patterns with preceding or dominant impact climate conditions provides not only a favourable environment for the production and distribution of insect species, but also affects crop growth and development, and ultimately the final yield. Recent efforts [7, 8] have analyzed the weather forecast to predict the risk of pests and thus, have applied pesticide in advance to avoid large scale damage to the valuable crops. In an effort to proffer a different approach to the solution of the pest management problems identified above, this work focuses on the problem of efficient precision pesticide application using predictive control based on dynamic demand management (DM).

The agricultural field is divided into multiple areas and then, using an active mass-spring suspension system, a dynamic model is created to demand the management of pesticide by considering the pest risk. This demand management model is then, used in conjunction with discrete-time model predictive control (DMPC) to determine the optimal time, place, and amount of pesticide to be used. On the other hand, in order to optimize the path taken by the vehicle/robot to apply pesticide in each sampling instant of DMPC, two different techniques were considered. Firstly, a greedy algorithm is proposed for a single vehicle to efficiently solve the vehicle routing problem and secondly, a DMPC based algorithm is proposed for a fleet of autonomous vehicles/robots to perform the task. However, the agricultural field is assumed to be a collection of different areas where, the demand for each area is generated using a mass-spring damper system. The demand for each area is thereby considered in each time step of a model predictive control (MPC) based algorithm to optimize the assignment of AVs in different areas as well as routing them. Thus, in each time interval, based on the predicted future states of the model, the vehicle routing is controlled so as to minimize the charge consumed and field coverage time after a certain time period.

1.2 Problem Statement

In most of the farming practices, pesticides are usually applied uniformly throughout the fields to control the spread of diseases despite the fact that several pests and diseases exhibit an uneven spatial distribution, especially during the early stages of development. Thus, it is important to apply an optimal amount of pesticide at an optimal time and place. The existing works suffer from one or more of the following problems. Firstly, pesticide application problems are formulated as a vehicle routing problem with fixed and pre-determined demand. This leads to static models which do not consider the dynamics of pest's infestation [7, 8, 15]. Secondly, most existing techniques either consider a simple model consisting of a single vehicle or a fixed layout for the agricultural field with multiple vehicles [9, 10]. This approach compromises the generality of the proposed techniques and results in limited applicability. Thirdly, as most of the existing techniques are based on optimization technique which only look at one time interval, the resulting assignment and scheduling of a fleet of vehicles to multiple areas result in poor coordination among the vehicles. This leads to inefficient fuel/charge consumption as well as longer field coverage time. Finally, most of the existing techniques use complex meta-heuristic-based optimization algorithms. This results in higher computational complexity for the proposed techniques and eventually, these techniques are not feasible for real-time control of autonomous vehicles.

In view of the aforementioned problems, this study focuses on solving the above issues by developing an efficient solution for pesticide management which considers dynamic pesticide demand using real-time risk of pests. Moreover, the proposed technique uses predictive control to improve coordination among a fleet of vehicles over an optimization window which goes beyond the current time interval by predicting the state for several future time intervals. This results in a larger covered area of the agricultural field.

1.3 Objectives

Given the aforementioned problem statement, the main objectives of this thesis are as follows:

i. Model dynamic pesticide demand management using an active mass-spring suspension system.

ii. Develop a discrete-time model predictive controller to reduce the demand for pesticide.

iii. Develop an autonomous on-demand scheduling and assignment algorithm to optimize pesticide application using a fleet of vehicles.

1.4 Scope

The scope and limitations of this work are as follows:

i. Although, the proposed technique does not consider a fixed layout for the agricultural field, the starting and ending points for each vehicle are considered the same.

ii. All vehicles consume charge at the same rate according to distance. Moreover, the charge rate at the charging station is considered to be the same for all vehicles.

iii. This study does not develop a pest risk prediction model. The use of any existing pest risk infection model is based on assumption. Thus, the performance of the proposed technique may be limited by the choice of a prediction model.

iv. It is assumed that all areas are connected through at least one path. The proposed technique assumes that only one vehicle can serve a given area at any one time.

v. All the simulations are performed in MATLAB/Simulink.

1.5 Research Significance

Some of the potential applications for this research are:

i. The proposed technique can be used to control the onset of a pest infection by optimizing pesticide application in advance,i.e., even if there are no pests but if the pest risk prediction model predicts the onset of pests, the proposed technique utilizes this information to avoid pest infestation before it occurs. Thus, unlike any existing technique, this research considers a pro-active approach which results in significant savings in terms of pesticide used as well as field coverage time (and according to fuel/charge).

ii. The proposed technique uses predictive control to efficiently coordinate a fleet of vehicles over multiple time intervals. However, the existing techniques can only perform optimization over one time interval. This results in significantly faster convergence times and lower fuel or charge consumption.

iii. MPC is well-known for its lower computational complexity as compared to evolutionary algorithms. Thus, the proposed technique takes advantage of this fact and uses MPC to efficiently solve the agricultural VRP problem.

iv. The proposed technique is the first of its kind which can be used for autonomous mobility on demand in the domain of agriculture.

1.6 Thesis Organization

The rest of this thesis is organized as follows:

Chapter 2 provides an elaborate discussion of the existing literature related to this thesis. In particular, the focus of this chapter is to provide a foundation for demand management technique in various sectors, an overview of multi-objective optimization problem (MOP) as used in agricultural VRP and various MPC techniques applied in the field of agriculture. Finally, the chapter concludes with the presentation of the research niche identified in the review which forms the objectives of this thesis.

Chapter 3 presents the proposed technique. Various aspects of the proposed technique are discussed including the use of an active mass-spring suspension system for state-space model formulation, the MPC plant model, and scheduling and assigning pesticide demand to a fleet of vehicles with charge and capacity constraints, etc.

Chapter 4 presents the evaluation of the proposed technique using simulations in MATLAB/Simulink. The various performance aspects discussed in this chapter include the system dynamics for stability, field coverage time and total charge consumed. Moreover, a comprehensive comparison with existing techniques in literature is also presented.

Finally, Chapter 5, presents the conclusions for this thesis and also highlights the future recommendations.

REFERENCES

1. Y. A. Davizón, R. Soto, J. D. J. Rodríguez, E. Rodríguez-Leal, C. Martínez-Olvera, and C. Hinojosa, "Demand management based on model predictive control techniques," *Mathematical Problems in Engineering*, vol. 2014, 2014.
2. D. Pimental. Boca Raton, FL, USA: CRC Press, 1991.
3. M. A. Mahmud, M. Z. Abidin, and Z. Mohamed, "Crop identification and navigation design based on probabilistic roadmap for crop inspection robot," in *International Conference on Agricultural and Food Engineering (Cafei2016)*, vol. 23, 2016, p. 25.
4. M. S. A. Mahmud, M. S. Z. Abidin, Z. Mohamed, M. K. I. Abd Rahman, and M. Iida, "Multi-objective path planner for an agricultural mobile robot in a virtual greenhouse environment," *Computers and Electronics in Agriculture*, vol. 157, pp. 488–499, 2019.
5. R. Olatinwo, J. Paz, S. Brown, R. Kemerait Jr, A. Culbreath, and G. Hoogenboom, "Impact of early spring weather factors on the risk of tomato spotted wilt in peanut," *Plant disease*, vol. 93, no. 8, pp. 783–788, 2009.
6. R. Olatinwo and G. Hoogenboom, "Weather-based pest forecasting for efficient crop protection," in *Integrated Pest Management*. Elsevier, 2014, pp. 59–78.
7. Q. Xiao, W. Li, Y. Kai, P. Chen, J. Zhang, and B. Wang, "Occurrence prediction of pests and diseases in cotton on the basis of weather factors by long short term memory network," *BMC bioinformatics*, vol. 20, no. 25, p. 688, 2019.
8. W. S. Kang, S. S. Hong, Y. K. Han, K. R. Kim, S. G. Kim, E. W. Park *et al.*, "A web-based information system for plant disease forecast based on weather data at high spatial resolution," *Plant Pathol. J*, vol. 26, pp. 37–48, 2010.
9. H. Seyyedhasani and J. S. Dvorak, "Using the vehicle routing problem to reduce field completion times with multiple machines," *Computers and Electronics in Agriculture*, vol. 134, pp. 142–150, 2017.

10. H. Seyyedhasani, “Using the vehicle routing problem (vrp) to provide logistic solutions in agriculture,” Ph.D. dissertation, 02 2018.

11. M. F. Jensen, D. Bochtis, and C. G. Sørensen, “Coverage planning for capacitated field operations, part ii: Optimisation,” *Biosystems Engineering*, vol. 139, pp. 149–164, 2015.

12. H. Bederina and M. Hifi, “A hybrid multi-objective evolutionary optimization approach for the robust vehicle routing problem,” *Applied Soft Computing*, vol. 71, pp. 980–993, 2018.

13. Y. Marinakis, M. Marinaki, and A. Migdalas, “A multi-adaptive particle swarm optimization for the vehicle routing problem with time windows,” *Information Sciences*, vol. 481, pp. 311–329, 2019.

14. A. Utamima, T. Reiners, and A. H. Ansaripoor, “Optimisation of agricultural routing planning in field logistics with evolutionary hybrid neighbourhood search,” *Biosystems Engineering*, vol. 184, pp. 166–180, 2019.

15. P. Wharton, W. Kirk, K. Baker, and L. Duynslager, “A web-based interactive system for risk management of potato late blight in michigan,” *Computers and Electronics in agriculture*, vol. 61, no. 2, pp. 136–148, 2008.

16. G. Zotos, A. Karagiannidis, S. Zampetoglou, A. Malamakis, I.-S. Antonopoulos, S. Kontogianni, and G. Tchobanoglous, “Developing a holistic strategy for integrated waste management within municipal planning: Challenges, policies, solutions and perspectives for hellenic municipalities in the zero-waste, low-cost direction,” *Waste Management*, vol. 29, no. 5, pp. 1686–1692, 2009.

17. H. Seah and N. Lee, “Technological enablers and confidence building in end-users for effective non-domestic water demand management,” *International Journal of Water Resources Development*, pp. 1–22, 2020.

18. V. Martinez, M. Zhao, C. Blujdea, X. Han, A. Neely, and P. Albores, “Blockchain-driven customer order management,” *International Journal of Operations & Production Management*, 2019.

19. R. R. Negenborn, P. J. van Overloop, T. Keviczky, and B. De Schutter, "Distributed model predictive control of irrigation canals," *Networks and Heterogeneous Media*, vol. 4, no. 2, pp. 359–380, Jun. 2009.

20. A. Kamilaris, A. Engelbrecht, A. Pitsillides, and F. X. Prenafeta-Boldú, "Transfer of manure as fertilizer from livestock farms to crop fields: The case of Catalonia," *Computers and Electronics in Agriculture*, vol. 175, Aug. 2020.

21. M. S. A. Mahmud, M. S. Z. Abidin, Z. Mohamed, M. K. I. A. Rahman, and M. Iida, "Multi-objective path planner for an agricultural mobile robot in a virtual greenhouse environment," *Computers and Electronics in Agriculture*, vol. 157, no. January, pp. 488–499, 2019.

22. C. M. Chen, K. T. Hua, J. T. Chyou, and C. C. Tai, "The effect of economic policy uncertainty on hotel room demand-evidence from Mainland Chinese and Japanese tourists in Taiwan," pp. 1443–1448, Jun. 2020.

23. K. C. Chung, "Green marketing orientation: achieving sustainable development in green hotel management," *Journal of Hospitality Marketing and Management*, vol. 29, no. 6, pp. 722–738, Aug. 2020.

24. V. Martinez, M. Zhao, C. Blujdea, X. Han, A. Neely, and P. Albores, "Blockchain-driven customer order management," *International Journal of Operations and Production Management*, vol. 39, pp. 993–1022, Dec. 2019.

25. B. Li and R. Roche, "Optimal scheduling of multiple multi-energy supply microgrids considering future prediction impacts based on model predictive control," *Energy*, vol. 197, p. 117180, Apr. 2020.

26. M. Yildirimoglu and M. Ramezani, "Demand management with limited cooperation among travellers: A doubly dynamic approach," *Transportation Research Part B: Methodological*, vol. 132, pp. 267–284, Feb. 2020.

27. I. Aguilar Alonso, J. Carrillo Verdún, and E. Tovar Caro, "Description of the structure of the IT demand management process framework," *International Journal of Information Management*, vol. 37, no. 1, pp. 1461–1473, Feb. 2017.

28. M. W. Khan, J. Wang, M. Ma, L. Xiong, P. Li, and F. Wu, "Optimal energy management and control aspects of distributed microgrid using multi-agent systems," pp. 855–870, Jan. 2019.

29. J. Holguín-Veras and I. Sánchez-Díaz, "Freight Demand Management and the Potential of Receiver-Led Consolidation programs," *Transportation Research Part A: Policy and Practice*, vol. 84, pp. 109–130, Feb. 2016.

30. L. H. Lee E P Chew M S Sim, "A heuristic to solve a sea cargo revenue management problem," *Springer*.

31. M. H. Giacomoni and E. Z. Berglund, "Complex Adaptive Modeling Framework for Evaluating Adaptive Demand Management for Urban Water Resources Sustainability," *Journal of Water Resources Planning and Management*, vol. 141, no. 11, p. 04015024, Nov. 2015.

32. H. Seah and N. Lee, "Technological enablers and confidence building in end-users for effective non-domestic water demand management," *International Journal of Water Resources Development*, pp. 1–22, Mar. 2020.

33. K. Li, S. Hajar, Z. Ding, T. Dooling, G. Wei, C. Hu, Y. Zhang, and K. Zhang, "Dynamic optimization of input production factors for urban industrial water supply and demand management," *Journal of Environmental Management*, vol. 270, p. 110807, Sep. 2020.

34. J. W. O'Neill and Y. Ouyang, "Predicting Lodging Demand Trends in the U.S. Hotel Industry," *Cornell Hospitality Quarterly*, vol. 61, no. 3, pp. 237–254, Aug. 2020.

35. I. Alonso, J. Verdún, E. C. I. J. o. Information, and undefined 2017, "Description of the structure of the IT demand management process framework," *Elsevier*.

36. K. Govindan, H. Mina, and B. Alavi, "A decision support system for demand management in healthcare supply chains considering the epidemic outbreaks: A case study of coronavirus disease 2019 (COVID-19)," *Transportation Research Part E: Logistics and Transportation Review*, vol. 138, p. 101967, Jun. 2020.

37. Y. F. Hung and C. H. Chen, “An effective dynamic decision policy for the revenue management of an airline flight,” *International Journal of Production Economics*, vol. 144, no. 2, pp. 440–450, Aug. 2013.

38. M. Graf and A. Kimms, “Transfer price optimization for option-based airline alliance revenue management,” in *International Journal of Production Economics*, vol. 145, no. 1. Elsevier, Sep. 2013, pp. 281–293.

39. A. Jacquillat and A. R. Odoni, “A roadmap toward airport demand and capacity management,” *Transportation Research Part A: Policy and Practice*, vol. 114, pp. 168–185, Aug. 2018.

40. C. Steinhardt and J. Gönsch, “Integrated revenue management approaches for capacity control with planned upgrades,” *European Journal of Operational Research*, vol. 223, no. 2, pp. 380–391, Dec. 2012.

41. T. F. Morris, T. L. Ellison, M. Mutabagani, S. I. Althawadi, and M. Heppenheimer, “Demand management and optimization of clinical laboratory services in a tertiary referral center in Saudi Arabia,” *Annals of Saudi Medicine*, vol. 38, no. 4, pp. 299–304, Jul. 2018.

42. J. Silvente, G. M. Kopanos, and A. Espuña, “A rolling horizon stochastic programming framework for the energy supply and demand management in microgrids,” in *Computer Aided Chemical Engineering*. Elsevier B.V., Jan. 2015, vol. 37, pp. 2321–2326.

43. X. Jin, J. Wu, Y. Mu, M. Wang, X. Xu, and H. Jia, “Hierarchical microgrid energy management in an office building,” *Applied Energy*, vol. 208, pp. 480–494, Dec. 2017.

44. A. Escriva-Bou, J. R. Lund, and M. Pulido-Velazquez, “Saving Energy From Urban Water Demand Management,” *Water Resources Research*, vol. 54, no. 7, pp. 4265–4276, Jul. 2018.

45. A. Hintsches, T. S. Spengler, T. Volling, K. Wittek, and G. Priegnitz, “Revenue Management in Make-To-Order Manufacturing: Case Study of Capacity Control at ThyssenKrupp VDM,” *Business Research*, vol. 3, no. 2, pp. 173–190, Nov. 2010.

46. Y. Cheng, F. Tao, L. Xu, and D. Zhao, "Advanced manufacturing systems: supply–demand matching of manufacturing resource based on complex networks and Internet of Things," *Enterprise Information Systems*, vol. 12, no. 7, pp. 780–797, Aug. 2018.

47. J. Silvente, A. M. Aguirre, M. A. Zamarripa, C. A. Méndez, M. Graells, and A. Espuña, "Improved time representation model for the simultaneous energy supply and demand management in microgrids," *Energy*, vol. 87, pp. 615–627, Jul. 2015.

48. A. C. de Araújo, E. M. Matsuoka, J. E. Ung, A. Massote, and M. Sampaio, "An exploratory study on the returns management process in an online retailer," *International Journal of Logistics Research and Applications*, vol. 21, no. 3, pp. 345–362, May 2018.

49. E. B. Mikobi, E. Nwobodo-Anyadiegwu, and C. Mbohwa, "Demand management practices in the manufacturing industry: An empirical South African perspective," in *2018 5th International Conference on Industrial Engineering and Applications, ICIEA 2018.* Institute of Electrical and Electronics Engineers Inc., Jun. 2018, pp. 60–66.

50. I. Masudin and M. S. Kamara, "Electronic Data Interchange and Demand Forecasting Implications on Supply Chain Management Collaboration: A Customer Service Perspective," *Jurnal Teknik Industri*, vol. 18, no. 2, p. 138, Sep. 2017.

51. K. L. Croxton, D. M. Lambert, S. J. García-Dastugue, and D. S. Rogers, "The Demand Management Process," *The International Journal of Logistics Management*, vol. 13, no. 2, pp. 51–66, Jul. 2002.

52. A. Kimms and M. Müller-Bungart, "Simulation of stochastic demand data streams for network revenue management problems," *OR Spectrum*, vol. 29, no. 1, pp. 5–20, 2007.

53. A. Gosavi, E. Ozkaya, and A. F. Kahraman, "Simulation optimization for revenue management of airlines with cancellations and overbooking," *OR Spectrum*, vol. 29, no. 1, pp. 21–38, 2007.

54. J. Feizabadi, “Machine learning demand forecasting and supply chain performance,” *International Journal of Logistics Research and Applications*, 2020.

55. T. Kraus, H. J. Ferreau, E. Kayacan, H. Ramon, J. De Baerdemaeker, M. Diehl, and W. Saeys, “Moving horizon estimation and nonlinear model predictive control for autonomous agricultural vehicles,” *Computers and Electronics in Agriculture*, vol. 98, pp. 250–233, Oct. 2013.

56. B. Rannou and D. Melli, “Measuring the impact of revenue management,” *Journal of Revenue and Pricing Management*, vol. 2, no. 3, pp. 261–270, 2003.

57. F. Defregger and H. Kuhn, “Revenue management for a make-to-order company with limited inventory capacity,” *OR Spectrum*, vol. 29, no. 1, pp. 137–156, 2007.

58. L. R. Weatherford and S. E. Kimes, “A comparison of forecasting methods for hotel revenue management,” *International Journal of Forecasting*, vol. 19, no. 3, pp. 401–415, Jul. 2003.

59. F. Borrelli, A. Bemporad, and M. Morari, *Predictive Control for Linear and Hybrid Systems*. Cambridge University Press, 2017.

60. J. Skaf, S. Boyd, and A. Zeevi, “Shrinking-horizon dynamic programming,” *International Journal of Robust and Nonlinear Control*, vol. 20, no. 17, pp. 1993–2002, Nov. 2010.

61. F. Noorian and P. H. W. Leong, “On time series forecasting error measures for finite horizon control,” *IEEE Transactions on Control Systems Technology*, vol. 25, no. 2, pp. 736–743, 2017.

62. A. Dontchev, I. Kolmanovsky, M. Krastanov, V. Veliov, and P. Vuong, “Approximating optimal finite horizon feedback by model predictive control,” *Systems & Control Letters*, vol. 139, p. 104666, 2020. [Online]. Available: http://www.sciencedirect.com/science/article/pii/S0167691120300463

63. J. Qin and T. Badgwell, “A survey of industrial model predictive control technology,” *Control engineering practice*, vol. 11, pp. 733–764, 07 2003.

64. P. Ignaciuk and A. Bartoszewicz, “Linear-quadratic optimal control of periodic-review perishable inventory systems,” *IEEE Transactions on Control Systems Technology*, vol. 20, no. 5, pp. 1400–1407, 2012.

65. J. Mohan, K. Lanka, and A. N. Rao, “A review of dynamic job shop scheduling techniques,” *Procedia Manufacturing*, vol. 30, pp. 34 – 39, 2019, digital Manufacturing Transforming Industry Towards Sustainable Growth. [Online]. Available: http://www.sciencedirect.com/science/article/pii/S2351978919300368

66. T. Zheng, *Advanced Model Predictive Control.* IntechOpen, 2011.

67. J. Lee, “Model predictive control: Review of the three decades of development,” *International Journal of Control, Automation and Systems*, vol. 9, pp. 415–424, 06 2011.

68. D. Q. Mayne, “Model predictive control: Recent developments and future promise,” *Automatica*, vol. 50, no. 12, pp. 2967 – 2986, 2014.

69. M. Pástor and J. Dudrik, “Comparison of mpc and pi controller for grid-connected cascade inverter,” *Elektronika Ir Elektrotechnika*, vol. 20, pp. 46–50, 2014.

70. U. Kalabic, R. Gupta, S. D. Cairano, A. Bloch, and I. Kolmanovsky, “Mpc on manifolds with an application to the control of spacecraft attitude on so(3),” *Autom.*, vol. 76, pp. 293–300, 2017.

71. V. Veselý and A. Ilka, “Robust controller design with input constraints,” *IFAC-PapersOnLine*, vol. 48, no. 14, pp. 198 – 203, 2015.

72. A. Marchetti, A. Ferramosca, and A. González, “Steady-state target optimization designs for integrating real-time optimization and model predictive control,” *Journal of Process Control*, vol. 24, no. 1, pp. 129 – 145, 2014.

73. M. Canale, L. Fagiano, and M. Signorile, “Design of robust predictive control laws using set membership identified models,” *Asian Journal of Control*, vol. 15, 11 2013.

74. T. A. N. Heirung, B. E. Ydstie, and B. Foss, “Dual adaptive model predictive control,” *Automatica*, vol. 80, pp. 340 – 348, 2017.

75. L. Fagiano and A. R. Teel, "Generalized terminal state constraint for model predictive control," *Automatica*, vol. 49, no. 9, pp. 2622 – 2631, 2013.

76. N. Saraf and A. Bemporad, "Fast model predictive control based on linear input/output models and bounded-variable least squares," in *2017 IEEE 56th Annual Conference on Decision and Control (CDC)*, 2017, pp. 1919–1924.

77. K. Kowalska and M. von Mohrenschildt, "An approach to variable time receding horizon control," *Optimal Control Applications and Methods*, vol. 33, no. 4, pp. 401–414, 2012.

78. M. S. Shahriar, M. A. Ahmed, M. I. Rahman, and A. I. Khan, "Comparison of mpc and conventional control methods for the stability enhancement of upfc connected smib system," in *2013 2nd International Conference on Advances in Electrical Engineering (ICAEE)*, 2013, pp. 223–228.

79. S. Yu, C. Hou, T. Qu, and H. Chen, "A revisit to mpc of discrete-time nonlinear systems," in *2015 IEEE International Conference on Cyber Technology in Automation, Control, and Intelligent Systems (CYBER)*, 2015, pp. 7–12.

80. D. Q. Mayne, J. B. Rawlings, C. V. Rao, and P. O. Scokaert, "Constrained model predictive control: Stability and optimality," *Automatica*, vol. 36, no. 6, pp. 789–814, Jun. 2000.

81. A. Ferramosca, D. Limon, I. Alvarado, T. Alamo, and E. F. Camacho, "MPC for tracking of constrained nonlinear systems," *Proceedings of the IEEE Conference on Decision and Control*, pp. 7978–7983, 2009.

82. A. Afram and F. Janabi-Sharifi, "Theory and applications of HVAC control systems - A review of model predictive control (MPC)," pp. 343–355, Feb. 2014.

83. P. D. Christofides, R. Scattolini, D. Muñoz de la Peña, and J. Liu, "Distributed model predictive control: A tutorial review and future research directions," *Computers and Chemical Engineering*, vol. 51, pp. 21–41, Apr. 2013.

84. J. D. P. Gene F. Franklin and A. F. Emami-Naeini, *Feedback Control of Dynamic Systems*, 7th ed. Pearson, 2015.

85. A. Kamilaris and F. X. Prenafeta-Boldú, "Deep learning in agriculture: A survey," pp. 70–90, Apr. 2018.

86. E. Kayacan, S. Member, E. Kayacan, S. Member, H. Ramon, O. Kaynak, and W. Saeys, "Towards Agrobots : Trajectory Control of an Autonomous Tractor Using Type-2 Fuzzy Logic Controllers," vol. 20, no. 1, pp. 287–298, 2015.

87. E. Kayacan, E. Kayacan, H. Ramon, and W. Saeys, "Distributed nonlinear model predictive control of an autonomous tractor-trailer system," in *Mechatronics*, vol. 24, no. 8. Elsevier Ltd, Dec. 2014, pp. 926–933.

88. E. Kayacan, H. Ramon, and W. Saeys, "Robust Trajectory Tracking Error Model-Based Predictive Control for Unmanned Ground Vehicles," vol. 21, no. 2, pp. 806–814, 2016.

89. Y. Bin and T. Shim, "Constrained model predictive control for backing-up tractor-trailer system," *Proceedings of the World Congress on Intelligent Control and Automation (WCICA)*, pp. 2165–2170, 2012.

90. F. Yakub and Y. Mori, "Comparative study of autonomous path-following vehicle control via model predictive control and linear quadratic control," *Proc IMechE Part D: J Automobile Engineering*, vol. 229, no. 12, pp. 1695–1714, 2015.

91. T. Coen, J. Anthonis, and J. De Baerdemaeker, "Cruise control using model predictive control with constraints," *Computers and Electronics in Agriculture*, vol. 63, no. 2, pp. 227–236, Oct. 2008.

92. J. Backman, T. Oksanen, and A. Visala, "Navigation system for agricultural machines: Nonlinear Model Predictive path tracking," *Computers and Electronics in Agriculture*, vol. 82, pp. 32–43, Mar. 2012.

93. C. Cariou, R. Lenain, B. Thuilot, and M. Berducat, "Autonomous Maneuvers of a Farm Vehicle with a Trailed Implement in Headland. Adap2E View project Control of mobile robots View project AUTONOMOUS MANEUVERS OF A FARM VEHICLE WITH A TRAILED IMPLEMENT IN HEADLAND," Tech. Rep., 2010.

94. M. K. Salahou, "Research Journal of Applied Sciences Engineering and Technology-Review Article Control of an Irrigation Canal," vol. 5, no. 15, pp. 3916–3924, 2013.

95. N. Yan-Hua, L. Ling-Min, and H. Guo-Bing, "Research on emergency control mode of sluice gates in water delivery canal."

96. D. Delgoda, H. Malano, S. K. Saleem, and M. N. Halgamuge, "Irrigation control based on model predictive control (MPC): Formulation of theory and validation using weather forecast data and AQUACROP model," *Environmental Modelling and Software*, vol. 78, pp. 40–53, Apr. 2016.

97. V. Puig, C. Ocampo-Martinez, J. Romera, J. Quevedo, R. Negenborn, P. Rodríguez, and S. De Campos, "Model predictive control of combined irrigation and water supply systems: Application to the Guadiana river," *Proceedings of 2012 9th IEEE International Conference on Networking, Sensing and Control, ICNSC 2012*, pp. 85–90, 2012.

98. A. C. McCarthy, N. H. Hancock, and S. R. Raine, "Simulation of irrigation control strategies for cotton using Model Predictive Control within the VARIwise simulation framework," *Computers and Electronics in Agriculture*, vol. 101, pp. 135–147, Feb. 2014.

99. J. V. Aguilar, P. Langarita, J. Rodellar, L. Linares, and K. Horváth, "Predictive control of irrigation canals – robust design and real-time implementation," *Water Resources Management*, vol. 30, no. 11, pp. 3829–3843, Sep. 2016.

100. L. Roca, J. Sánchez, F. Rodríguez, J. Bonilla, A. de la Calle, and M. Berenguel, "Predictive Control Applied to a Solar Desalination Plant Connected to a Greenhouse with Daily Variation of Irrigation Water Demand," *Energies*, vol. 9, no. 3, p. 194, Mar. 2016.

101. R. Scattolini, "Architectures for distributed and hierarchical Model Predictive Control - A review," pp. 723–731, May 2009.

102. R. Zhang, A. Liu, L. Yu, and W. A. Zhang, "Distributed model predictive control based on nash optimality for large scale irrigation systems," in *IFAC-PapersOnLine*, vol. 28, no. 8. Elsevier, Jul. 2015, pp. 551–555.

103. M. Xu, "Model Predictive Control of an Irrigation Canal Using Dynamic Target Trajectory," *Journal of Irrigation and Drainage Engineering*, vol. 143, no. 3, p. B4016004, Mar. 2017.

104. Sutrisno, Salmah, and I. E. Wijayanti, "Distributed model predictive control and application to irrigation canal," *Proceedings of 2012 IEEE Conference on Control, Systems and Industrial Informatics, ICCSII 2012*, no. 978, pp. 126–130, 2012.

105. A. Farhadi and A. Khodabandehlou, "Distributed model predictive control with hierarchical architecture for communication: application in automated irrigation channels," *International Journal of Control*, vol. 89, no. 8, pp. 1725–1741, Aug. 2016.

106. J. M. Lemos, F. Machado, N. Nogueira, L. Rato, and M. Rijo, "Adaptive and non-adaptive model predictive control of an irrigation channel," *Networks & Heterogeneous Media*, vol. 4, no. 2, pp. 303–324, Jun. 2009.

107. M. Kearney, M. Cantoni, and P. M. Dower, "Non-iterative distributed MPC for large-scale irrigation channels," *Proceedings of the 2011 Australian Control Conference, AUCC 2011*, no. November, pp. 217–223, 2011.

108. A. Álvarez, M. A. Ridao, D. R. Ramirez, and L. Sánchez, "Constrained Predictive Control of an Irrigation Canal," *Journal of Irrigation and Drainage Engineering*, vol. 139, no. 10, pp. 841–854, Oct. 2013.

109. F. Fele, J. M. Maestre, F. J. Muros, and E. F. Camacho, "Coalitional control: An irrigation canal case study," *2013 10th IEEE International Conference on Networking, Sensing and Control, ICNSC 2013*, pp. 759–764, 2013.

110. F. Fele, J. M. Maestre, S. M. Hashemy, D. Muñoz De La Peña, and E. F. Camacho, "Coalitional model predictive control of an irrigation canal," *Journal of Process Control*, vol. 24, no. 4, pp. 314–325, Apr. 2014.

111. A. Zafra-Cabeza, J. M. Maestre, M. A. Ridao, E. F. Camacho, and L. Sánchez, "Hierarchical distributed model predictive control for risk mitigation: An irrigation canal case study," *Proceedings of the American Control Conference*, pp. 3172–3177, 2011.

112. Y. Li, "On supervisory control of the main southern channel," *2014 IEEE Conference on Control Applications, CCA 2014*, pp. 2165–2170, 2014.

113. Y. Ding, L. Wang, Y. Li, and D. Li, "Model predictive control and its application in agriculture : A review," *Computers and Electronics in Agriculture*, vol. 151, no. May, pp. 104–117, 2018.

114. M. Bounkhel and L. Tadj, "Optimal harvesting effort for nonlinear predictive control model for a single species fishery," *Mathematical Problems in Engineering*, vol. 2015, 2015.

115. J. Liu, X. shuan Zhang, Z. Fu, and Q. Donglu, "Analysis of aquatic products price model using predictive control theory," 2012.

116. Q. Liu and F. Bakker-Arkema, "A model-predictive controller for grain drying," *Journal of Food Engineering*, vol. 49, no. 4, pp. 321–326, Sep. 2001.

117. F. Han, C. Zuo, W. Wu, J. Li, and Z. Liu, "Model predictive control of the grain drying process," *Mathematical Problems in Engineering*, vol. 2012, 2012.

118. L. Zhang, H. Cui, H. Li, F. Han, Y. Zhang, and W. Wu, "Parameters online detection and model predictive control during the grain drying process," *Mathematical Problems in Engineering*, vol. 2013, 2013.

119. A. Hernandez, R. De Keyser, J. Manrique, J. Oliden, and W. Ipanaqué, "Modeling and nonlinear model predictive control of a rotary disc dryer for fishmeal production," in *2014 European Control Conference (ECC)*, 2014, pp. 1819–1824.

120. H. Zhou, J. Liu, D. Jayas, Z. Wu, and X. Zhou, "A distributed parameter model predictive control method for forced air ventilation through stored grain," *Applied Engineering in Agriculture*, vol. 30, pp. 593–600, 07 2014.

121. J. Gruber, J. Guzmán, F. Rodríguez, C. Bordons, M. Berenguel, and J. Sánchez, "Nonlinear mpc based on a volterra series model for greenhouse temperature control using natural ventilation," *Control Engineering Practice*, vol. 19, no. 4, pp. 354–366, 2011.

122. H. Hu, L. Xu, R. Wei, and B. Zhu, "Multi-objective control optimization for greenhouse environment using evolutionary algorithms," *Sensors*, vol. 11, no. 6, p. 5792–5807, May 2011.

123. K. Ito, "Greenhouse temperature control with wooden pellet heater via model predictive control approach," pp. 4–9, 2012.

124. R. González, F. Rodríguez, J. L. Guzmán, and M. Berenguel, "Robust constrained economic receding horizon control applied to the two time-scale dynamics problem of a greenhouse," *Optimal Control Applications and Methods*, vol. 35, no. 4, pp. 435–453, Jul. 2014.

125. R. Singhal, R. Kumar, and S. Neeli, "Receding horizon control based on prioritised multi-operational ranges for greenhouse environment regulation," *Computers and Electronics in Agriculture*, vol. 180, p. 105840, 2021.

126. N. Boutchich, A. Moufid, N. Bennis, and S. E. Hani, "A constrained mpc approach applied to buck dc-dc converter for greenhouse powered by photovoltaic source," in *2020 International Conference on Electrical and Information Technologies (ICEIT)*, 2020, pp. 1–6.

127. J. P. Coelho, P. B. De Moura Oliveira, and J. B. Cunha, "Greenhouse air temperature predictive control using the particle swarm optimisation algorithm," in *Computers and Electronics in Agriculture*, vol. 49, no. 3. Elsevier, Dec. 2005, pp. 330–344.

128. M. Ramdani, A. Hamza, and M. Boughamsa, "Multiscale fuzzy model-based short term predictive control of greenhouse microclimate," in *2015 IEEE 13th International Conference on Industrial Informatics (INDIN)*, 2015, pp. 1348–1353.

129. M. Guoqi, Q. Linlin, L. Xinghua, and W. Gang, "Modeling and predictive control of greenhouse temperature-humidity system based on mld and time-series," in *2015 34th Chinese Control Conference (CCC)*, 2015, pp. 2234–2239.

130. M. M. Graf Plessen and A. Bemporad, "Reference trajectory planning under constraints and path tracking using linear time-varying model predictive control for agricultural machines," *Biosystems Engineering*, vol. 153, pp. 28–41, Jan. 2017.

131. J. Kalmari, J. Backman, and A. Visala, "Coordinated motion of a hydraulic forestry crane and a vehicle using nonlinear model predictive control," *Computers and Electronics in Agriculture*, vol. 133, pp. 119–127, Feb. 2017.

132. A. Sadowska, B. D. Schutter, S. Member, and P.-j. V. Overloop, "Delivery-Oriented Hierarchical Predictive Control of an Irrigation Canal : Event-Driven Versus Time-Driven Approaches," vol. 23, no. 5, pp. 1701–1716, 2015.

133. D. Gaida, C. Wolf, T. Back, and M. Bongards, "Nonlinear model predictive substrate feed control of biogas plants," *2012 20th Mediterranean Conference on Control and Automation, MED 2012 - Conference Proceedings*, pp. 652–657, 2012.

134. A. Pawlowski, J. L. Guzmán, J. E. Normey-Rico, and M. Berenguel, "Improving feedforward disturbance compensation capabilities in Generalized Predictive Control," *Journal of Process Control*, vol. 22, no. 3, pp. 527–539, 2012.

135. S. Ri, O. Lq, W. K. H. Dqg, R. Vwhp, I. R. U. Wkh, U. Qylurqphqwdo, K. H. Q. Rqjkxl, and D. L. L. Ydoxhv, "$Ssolfdwlrqv Ri '0& 3,' $Ojrulwkp Lq Wkh 0Hdvxuhphqw Dqg &Rqwuro 6\Vwhp Iru Wkh *Uhhqkrxvh (Qylurqphqwdo)Dfwruv," pp. 483–485, 2011.

136. Z. Zhu, Y. Zhang, Z. Ji, S. He, and X. Yang, "High-throughput dna sequence data compression," pp. 639–655, 2013.

137. V. JÄÄSKINEN, J. XIONG, J. CORANDER, and T. KOSKI, "Sparse markov chains for sequence data," *Scandinavian Journal of Statistics*, vol. 41, no. 3, pp. 639–655, 2014.

138. H. Antil, S. E. Field, F. Herrmann, R. H. Nochetto, and M. Tiglio, "Two-step greedy algorithm for reduced order quadratures," *Journal of Scientific Computing*, vol. 57, pp. 604–637, 12 2013.

139. S. Bouamama and C. Blum, "A hybrid algorithmic model for the minimum weight dominating set problem," *Simulation Modelling Practice and Theory*, vol. 64, pp. 57–68, 5 2016.

140. M. X. Song, K. Chen, Z. Y. He, and X. Zhang, *Energy*, vol. 67, pp. 454–459, 4 2014.

141. M. Khaledi, A. Rovira-Sugranes, F. Afghah, and A. Razi, "On greedy routing in dynamic uav networks." Institute of Electrical and Electronics Engineers Inc., 6 2018, pp. 1–5.

142. Z. Jiang, V. Sahasrabudhe, A. Mohamed, H. Grebel, and R. Rojas-Cessa, "Greedy algorithm for minimizing the cost of routing power on a digital microgrid," *Energies*, vol. 12, p. 3076, 8 2019.

143. S. X. Wang, "The improved dijkstra's shortest path algorithm and its application," vol. 29. Elsevier, 1 2012, pp. 1186–1190.

144. K. Golubev, A. Zagarskikh, and A. Karsakov, "Dijkstra-based terrain generation using advanced weight functions," vol. 101. Elsevier B.V., 1 2016, pp. 152–160.

145. N. Gupta, K. Mangla, A. K. Jha, and M. Umar, "Applying dijkstras algorithm in routing process," *International Journal of New Technology and Research*, vol. 2, no. 5, 5 2016.

146. D. Baeza, C. F. Ihle, and J. M. Ortiz, "A comparison between aco and dijkstra algorithms for optimal ore concentrate pipeline routing," *Journal of Cleaner Production*, vol. 144, pp. 149–160, 2 2017.

147. H. Friedrich and J. Gumpp, "Simplified modeling and solving of logistics optimization problems," *International Journal of Transportation*, vol. 2, pp. 33–52, 4 2014.

148. M. S. A. Mahmud, M. S. Z. Abidin, A. A. Emmanuel, and H. S. Hasan, "Robotics and automation in agriculture: Present and future applications," pp. 130–140, 4 2020.

149. F. Duchon, A. Babinec, M. Kajan, P. Beno, M. Florek, T. Fico, and L. Jurišica, "Path planning with modified a star algorithm for a mobile robot," vol. 96. Elsevier Ltd, 1 2014, pp. 59–69.

150. B. Fu, L. Chen, Y. Zhou, D. Zheng, Z. Wei, J. Dai, and H. Pan, "An improved a* algorithm for the industrial robot path planning with high success rate and short length," *Robotics and Autonomous Systems*, vol. 106, pp. 26–37, 8 2018.

151. A. K. Guruji, H. Agarwal, and D. Parsediya, "Time-efficient a* algorithm for robot path planning," *Procedia Technology*, vol. 23, pp. 144–149, 1 2016.

152. C. H. Liu, C. X. Lin, I. C. Chen, D. T. Lee, and T. C. Wang, “Efficient multilayer obstacle-avoiding rectilinear steiner tree construction based on geometric reduction,” *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems*, vol. 33, pp. 1928–1941, 2014.

153. J. Lai, H. Zhou, W. Hu, D. Zhou, and L. Zhong, “Smart demand response based on smart homes,” *Mathematical Problems in Engineering*, vol. 2015, 2015.

154. M. Okulewicz and J. Mańdziuk, “Dynamic vehicle routing problem: A monte carlo approach,” *arXiv*, 6 2020.

155. D. D. Le, F. Zhou, and M. Molnar, “Minimizing blocking probability for the multicast routing and wavelength assignment problem in wdm networks: Exact solutions and heuristic algorithms,” *Journal of Optical Communications and Networking*, vol. 7, pp. 36–48, 1 2015.

156. H. Li, Q. Xia, and Y. Wang, “Research and improvement of kruskal algorithm,” *Journal of Computer and Communications*, vol. 05, pp. 63–69, 9 2017.

157. G. B. Dantzig and J. H. Ramser, “The truck dispatching problem,” *Manage. Sci.*, vol. 6, no. 1, p. 80–91, Oct. 1959.

158. T. Andersen, “Optimised Vehicle Routing in Autonomous Weed Control (Honours Thesis) COLLEGE OF SCIENCE & ENGINEERING Optimised Vehicle Routing in Autonomous Weed Control Bachelor of Science with Honours (Mathematics),” no. March, 2019.

159. J.-F. Cordeau, G. Laporte, M. Savelsbergh, and D. Vigo, *Vehicle Routing*, 01 2007, vol. 14, pp. 195–224.

160. R. Baldacci, N. Christofides, and A. Mingozzi, “An exact algorithm for the vehicle routing problem based on the set partitioning formulation with additional cuts,” *Math. Program.*, vol. 115, no. 2, p. 351–385, Jun. 2008.

161. H. Seyyedhasani, “Using the vehicle routing problem (vrp) to provide logistics solutions in agriculture,” 2017.

162. M. Saiful, A. Mahmud, M. Shukri, and Z. Abidin, “Enhanced Probabilistic Roadmap for Robot Navigation in Virtual Greenhouse Environment,” vol. 751, pp. 172–182, 2017.

163. M. Patel, H. Sahoo, and C. Kathuria, “Navigation control of a mobile robotic system in semi-structured and dynamic environment for controlled dose delivery of pesticides,” *ieeexplore.ieee.org*.

164. D. D. Bochtis and C. G. Sørensen, “The vehicle routing problem in field logistics part I,” *Biosystems Engineering*, vol. 104, no. 4, pp. 447–457, 2009.

165. K. C. Swain, Q. U. Zaman, A. W. Schumann, D. C. Percival, and D. D. Bochtis, “Computer vision system for wild blueberry fruit yield mapping,” *Biosystems Engineering*, vol. 106, no. 4, pp. 389–394, Aug. 2010.

166. I. Hameed, D. Bochtis, C. Sørensen, and M. Nøremark, “Automated generation of guidance lines for operational field planning,” *Biosystems Engineering*, vol. 107, no. 4, pp. 294 – 306, 2010.

167. A. Kaim, A. F. Cord, and M. Volk, “A review of multi-criteria optimization techniques for agricultural land use allocation,” *Environmental Modelling & Software*, vol. 105, pp. 79–93, Jul. 2018.

168. O. İlker Kolak, O. Feyzioğlu, and N. Noyan, “Bi-level multi-objective traffic network optimisation with sustainability perspective,” *Expert Systems with Applications*, vol. 104, pp. 294–306, 2018.

169. H. Seyyedhasani, J. S. Dvorak, and E. Roemmele, “Routing algorithm selection for field coverage planning based on field shape and fleet size,” *Computers and Electronics in Agriculture*, vol. 156, pp. 523–529, 2019.

170. D. Xu, K. Li, X. Zou, and L. Liu, “An unpaired pickup and delivery vehicle routing problem with multi-visit,” *Transportation Research Part E: Logistics and Transportation Review*, vol. 103, pp. 218–247, Jul. 2017.

171. C. Archetti, M. Savelsbergh, and M. G. Speranza, “The Vehicle Routing Problem with Occasional Drivers,” *European Journal of Operational Research*, vol. 254, no. 2, pp. 472–480, Oct. 2016.

172. M. Schneider, “The vehicle-routing problem with time windows and driver-specific times,” *European Journal of Operational Research*, vol. 250, no. 1, pp. 101–119, Apr. 2016.

173. A. Martínez-Puras and J. Pacheco, "MOAMP-Tabu search and NSGA-II for a real Bi-objective scheduling-routing problem," *Knowledge-Based Systems*, vol. 112, pp. 92–104, Nov. 2016.

174. S. B. Ebrahimi, "A stochastic multi-objective location-allocation-routing problem for tire supply chain considering sustainability aspects and quantity discounts," *Journal of Cleaner Production*, vol. 198, pp. 704–720, Oct. 2018.

175. A. Kimms and M. Maiwald, "Bi-objective safe and resilient urban evacuation planning," *European Journal of Operational Research*, vol. 269, no. 3, pp. 1122–1136, Sep. 2018.

176. L. Comba, P. Gay, J. Primicerio, and D. Ricauda Aimonino, "Vineyard detection from unmanned aerial systems images," *Computers and Electronics in Agriculture*, vol. 114, pp. 78–87, Jun. 2015.

177. T. T. N. Nguyet, T. V. Hoai, and N. A. Thi, "Some Advanced Techniques in Reducing Time for Path Planning Based on Visibility Graph," in *2011 Third International Conference on Knowledge and Systems Engineering*. IEEE, Oct. 2011, pp. 190–194.

178. C. Xiao-dong, Z. De-yun, and Z. Ruo-nan, "New method for UAV online path planning," in *2013 IEEE International Conference on Signal Processing, Communication and Computing (ICSPCC 2013)*. IEEE, Aug. 2013, pp. 1–5.

179. J. Conesa-Muñoz, G. Pajares, and A. Ribeiro, "Mix-opt: A new route operator for optimal coverage path planning for a fleet in an agricultural environment," *Expert Systems with Applications*, vol. 54, no. C, pp. 364–378, Jul. 2016.

180. N.-a. Mokhtari and V. Ghezavati, "Integration of efficient multi-objective ant-colony and a heuristic method to solve a novel multi-objective mixed load school bus routing model," *Applied Soft Computing*, vol. 68, pp. 92–109, Jul. 2018.

181. W. Wu, Y. Tian, and T. Jin, "A label based ant colony algorithm for heterogeneous vehicle routing with mixed backhaul," *Applied Soft Computing*, vol. 47, pp. 224–234, Oct. 2016.

182. M. Elhassania, E. A. Ahmed, and B. Jaouad, “Application of an ant colony system to optimize the total distance and the customers response time for the real time vehicle routing problem,” in *2016 3rd International Conference on Logistics Operations Management (GOL).* IEEE, May 2016, pp. 1–6.

183. J. Kennedy and R. Eberhart, “Particle swarm optimization,” in *Proceedings of ICNN’95 - International Conference on Neural Networks*, vol. 4. IEEE, pp. 1942–1948.

184. A.-l. Chen, G. Yang, and Z.-m. Wu, “Hybrid discrete particle swarm optimization algorithm for capacitated vehicle routing problem,” *Journal of Zhejiang University - Science A: Applied Physics & Engineering*, vol. 7, pp. 607–614, 01 2006.

185. M. Rabbani, M. Aramoon Bajestani, and G. Baharian Khoshkhou, “A multi-objective particle swarm optimization for project selection problem,” *Expert Systems with Applications*, vol. 37, no. 1, pp. 315–321, Jan. 2010.

186. A. Ghaderi, M. S. Jabalameli, F. Barzinpour, and R. Rahmaniani, “An Efficient Hybrid Particle Swarm Optimization Algorithm for Solving the Uncapacitated Continuous Location-Allocation Problem,” *Networks and Spatial Economics*, vol. 12, no. 3, pp. 421–439, Sep. 2012.

187. K. Sethanan and W. Neungmatcha, “Multi-objective particle swarm optimization for mechanical harvester route planning of sugarcane field operations,” *European Journal of Operational Research*, vol. 252, no. 3, pp. 969–984, 2016.

188. Y. Xiao and A. Konak, “A genetic algorithm with exact dynamic programming for the green vehicle routing & scheduling problem,” *Journal of Cleaner Production*, vol. 167, pp. 1450–1463, Nov. 2017.

189. A. K. Beheshti, S. R. Hejazi, and M. Alinaghian, “The vehicle routing problem with multiple prioritized time windows: A case study,” *Computers & Industrial Engineering*, vol. 90, pp. 402–413, Dec. 2015.

190. Z. A. Chami, H. Manier, M.-A. Manier, and C. Fitouri, “A hybrid genetic algorithm to solve a multi-objective Pickup and Delivery Problem,” *IFAC-PapersOnLine*, vol. 50, no. 1, pp. 14 656–14 661, Jul. 2017.

191. R. S. Mendes, E. F. Wanner, J. F. Sarubbi, and F. V. Martins, "Optimization of the vehicle routing problem with demand responsive transport using the nsga-II algorithm," *IEEE Conference on Intelligent Transportation Systems, Proceedings, ITSC*, pp. 2657–2662, 2016.

192. J. Conesa-muñoz, A. Ribeiro, A. Rey, D. Andujar, and C. Fernandez-quintanilla, "Multi-path planning based on a NSGA-II for a fleet of robots to work on agricultural tasks," pp. 10–15, 2012.

193. K. Deb, A. Pratap, S. Agarwal, and T. Meyarivan, "A Fast and Elitist Multiobjective Genetic Algorithm: NSGA-II," Tech. Rep. 2, 2002.

194. H. Seyyedhasani and J. S. Dvorak, "Using the Vehicle Routing Problem to reduce field completion times with multiple machines," *Computers and Electronics in Agriculture*, vol. 134, pp. 142–150, Mar. 2017.

195. K. Li, K. Deb, Q. Zhang, and S. Kwong, "An Evolutionary Many-Objective Optimization Algorithm Based on Dominance and Decomposition," *IEEE Transactions on Evolutionary Computation*, vol. 19, no. 5, pp. 694–716, Oct. 2015.

196. R. H. Bhesdadiya, I. N. Trivedi, P. Jangir, N. Jangir, and A. Kumar, "An NSGA-III algorithm for solving multi-objective economic/environmental dispatch problem," *Cogent Engineering*, vol. 3, no. 1, Dec. 2016.

197. D. D. Bochtis, P. Dogoulis, P. Busato, C. G. Sørensen, R. Berruto, and T. Gemtos, "A flow-shop problem formulation of biomass handling operations scheduling," *Computers and Electronics in Agriculture*, vol. 91, pp. 49–56, 2013.

198. M. G. Plessen, "GPU-accelerated logistics optimisation for biomass production with multiple simultaneous harvesters tours, fields and plants," *Biomass and Bioenergy*, vol. 141, Oct. 2020.

199. A. Bakhtiari, H. Navid, J. Mehri, R. Berruto, and D. D. Bochtis, "Operations planning for agricultural harvesters using ant colony optimization," *Spanish Journal of Agricultural Research*, vol. 11, no. 3, pp. 652–660, 2013.

200. M. Saiful, A. Mahmud, M. Shukri, Z. Abidin, and Z. Mohamed, "Implementation of Binary Particle Swarm Optimization and Genetic Algorithm in Solving Mobile Robot Routing Problem in Agriculture."

201. H. Seyyedhasani and J. S. Dvorak, "Using the vehicle routing problem to reduce field completion times with multiple machines," *Computers and Electronics in Agriculture*, vol. 134, pp. 142–150, 2017.

202. S. Tiwari, H. M. Wee, and Y. Daryanto, "Big data analytics in supply chain management between 2010 and 2016: Insights to industries," *Computers and Industrial Engineering*, vol. 115, pp. 319–330, Jan. 2018.

203. G. A. Bula, C. Prodhon, F. A. Gonzalez, H. M. Afsar, and N. Velasco, "Variable neighborhood search to solve the vehicle routing problem for hazardous materials transportation," *Journal of Hazardous Materials*, vol. 324, pp. 472–480, Feb. 2017.

204. A. K. Shukla, R. Nath, and P. K. Muhuri, "NSGA-II based multi-objective pollution routing problem with higher order uncertainty," *IEEE International Conference on Fuzzy Systems*, 2017.

205. B. Vahdani, D. Veysmoradi, F. Noori, and F. Mansour, "Two-stage multi-objective location-routing-inventory model for humanitarian logistics network design under uncertainty," *International Journal of Disaster Risk Reduction*, vol. 27, pp. 290–306, 2018.

206. M. Rabbani, R. Heidari, and R. Yazdanparast, "A stochastic multi-period industrial hazardous waste location-routing problem: Integrating NSGA-II and Monte Carlo simulation," *European Journal of Operational Research*, vol. 272, no. 3, pp. 945–961, 2019.

207. W. Wu and L. Li, "Optimization method of control for transformer DC bias due to multi factors based on NSGA-III," *Proceedings - 9th International Conference on Intelligent Human-Machine Systems and Cybernetics, IHMSC 2017*, vol. 2, pp. 308–311, 2017.

208. Y. Wu, H. Yang, J. Tang, and Y. Yu, "Multi-objective re-synchronizing of bus timetable: Model, complexity and solution," *Transportation Research Part C: Emerging Technologies*, vol. 67, no. 2, pp. 149–168, 2016.

209. S. Wang, Y. Zhou, and J. Zhang, "An Improved NSGA-III Approach to Many-Objective Optimal Power Flow Problems," *Proceedings 2018 Chinese Automation Congress, CAC 2018*, no. 61403321, pp. 2664–2669, 2019.

210. S. Azimi, M. S. Zainal Abidin, and Z. Mohamed, "Crop identification and navigation design based on probabilistic roadmap for crop inspection robot," 08 2016.

211. R. Olatinwo and G. Hoogenboom, *Weather-based Pest Forecasting for Efficient Crop Protection*, 01 2013, pp. 59–76.

212. P. Wharton, W. Kirk, K. Baker, and L. Duynslager, "A web-based interactive system for risk management of potato late blight in michigan," *Computers and Electronics in Agriculture*, vol. 61, no. 2, pp. 136–148, 2008.

213. R. Olatinwo, J. Paz, S. Brown, R. Kemerait, A. Culbreath, and G. Hoogenboom, "Impact of early spring weather factors on the risk of tomato spotted wilt in peanut," *Plant Disease - PLANT DIS*, vol. 93, pp. 783–788, 08 2009.

214. R. Mita, G. Palumbo, and M. Poli, "Pseudo-random sequence generators with improved inviolability performance," *Circuits, Devices and Systems, IET Proceedings* -, vol. 153, pp. 375– 382, 09 2006.

215. H. Habib, M. Saleh, M. Rasmy, and H. Elshishiny, "Dynamic room pricing model for hotel revenue management systems," *Egyptian Informatics Journal*, vol. 12, pp. 177–183, 11 2011.

216. D. Walczak and S. Brumelle, "Semi-markov information model for revenue management and dynamic pricing," *OR Spectrum*, vol. 29, pp. 61–83, 01 2007.

217. C. Heo, *Restaurant Revenue Management*, 05 2013.

218. B. Bahreyni, "Chapter 5 - modelling of dynamics," in *Fabrication and Design of Resonant Microdevices*, ser. Micro and Nano Technologies, B. Bahreyni, Ed. Norwich, NY: William Andrew Publishing, 2009, pp. 79–111.

219. M. Balas, "Feedback control of flexible systems," *IEEE Transactions on Automatic Control*, vol. 23, no. 4, pp. 673–679, 1978.

220. L. Wang, *Discrete-time MPC for Beginners*. London: Springer London, 2009, pp. 1–42.

221. L. Meng, C. Zhang, Y. Ren, B. Zhang, and C. Lv, "Mixed-integer linear programming and constraint programming formulations for solving distributed flexible job shop scheduling problem," *Computers & Industrial Engineering*, vol. 142, p. 106347, 2020.

222. J. Arriaga, I. García-Tejero, J. Muriel-Fernández, V. Durán-Zuazo, and F. Rubio, "Modeling, simulation and control of irrigation on young almond trees," *Acta Horticulture*, vol. 1038, pp. 479–486, 2014.

223. R. Tanaka and T. Koga, "An approach to linear active disturbance rejection controller design with a linear quadratic regulator for a non-minimum phase system," in *2019 Chinese Control Conference (CCC)*, 2019, pp. 250–255.

224. M. Mohammed, "A review of genetic algorithm applications in solving vehicle routing problem," *Journal of Engineering and Applied Sciences*, vol. 12, pp. 4267–4283, 09 2017.

225. D. Henderson, S. Jacobson, and A. Johnson, *The Theory and Practice of Simulated Annealing*, 04 2006, pp. 287–319.

226. F. Glover, "Tabu search—part ii," *ORSA Journal on Computing*, vol. 2, pp. 4–32, 02 1990.

227. J. Kennedy and R. Eberhart, "Particle swarm optimization," in *Proceedings of ICNN'95 - International Conference on Neural Networks*, vol. 4, 1995, pp. 1942–1948 vol.4.

228. Y. Marinakis, M. Marinaki, and A. Migdalas, "A multi-adaptive particle swarm optimization for the vehicle routing problem with time windows," *Information Sciences*, vol. 481, pp. 311–329, 2019.

229. T. J. Ai and V. Kachitvichyanukul, "A particle swarm optimization for the vehicle routing problem with simultaneous pickup and delivery," *Computers & Operations Research*, vol. 36, no. 5, pp. 1693–1702, 2009, selected papers presented at the Tenth International Symposium on Locational Decisions (ISOLDE X).

230. V. Santucci, M. Baioletti, and A. Milani, “An algebraic framework for swarm and evolutionary algorithms in combinatorial optimization,” *Swarm and Evolutionary Computation*, vol. 55, p. 100673, 2020.

231. ASEAN, “Guidelines for the conduct of pest risk analysis for asean,” 2013.

232. S. Al-hayali, O. Ucan, and O. Bayat, “Genetic algorithm for finding shortest paths problem,” in *Proceedings of the Fourth International Conference on Engineering; MIS 2018*, ser. ICEMIS ’18. New York, NY, USA: Association for Computing Machinery, 2018.

233. N. Rathore, P. Jain, and M. Parida, *A MATLAB-Based Application to Solve Vehicle Routing Problem Using GA*, 01 2020, pp. 285–298.

234. A. Mohan, A. Dileep, S. Ajayan, G. Gutjahr, and P. Nedungadi, *Comparison of Metaheuristics for a Vehicle Routing Problem in a Farming Community*, 04 2020, pp. 49–63.

235. S. Richter, C. N. Jones, and M. Morari, “Computational complexity certification for real-time mpc with input constraints based on the fast gradient method,” *IEEE Transactions on Automatic Control*, vol. 57, no. 6, pp. 1391–1403, 2012.

LIST OF PUBLICATIONS

Journal with Impact Factor

1. U. Zangina, S. Buyamin, M. Naveed M. S. Z. Abidin, and M. S. A. Mahmud, "A Greedy Approach to Improve Pesticide Application for Precision Agriculture using Model Predictive Control",in Elsevier Computer and Electronics in Agriculture, vol. 182, no. December 2020, p. 105984, 2021. (Q1, Impact Factor: 5.565)
2. U. Zangina, S. Buyamin, M. S. Z. Abidin, and M. S. A. Mahmud, "Agricultural Rout Planning with Variable Rate Pesticide Application in a Greenhouse Environment", in Alexandria Eng. J., vol. 60, no. 3, pp. 3007–3020, 2021. (Q2, Impact Factor: 2.460)
3. U. Zangina, S. Buyamin, M. Naveed M. S. Z. Abidin, and M. S. A. Mahmud, "Autonomous Mobility of a Fleet of vehicles for Precision Pesticide Application", in Elsevier Computer and Electronics in Agriculture, vol. 186, no. April, 2021, p. 106217, 2021.(Q1, Impact Factor: 5.565)
4. U. Zangina, S. Buyamin, M. S. Z. Abidin, and M. S. A. Mahmud,,"Multi-Objective Pathfinding for Autonomous Robot in a Greenhouse Agriculture.", under review in PlosOne. (Q2, Impact Factor: 2.740)

Indexed Journal (SCOPUS)

1. U. Zangina, S. Buyamin, M. S. Z. Abidin, M. S. A. Mahmud, and H. S. Hasan,"Non-linear PID controller for trajectory tracking of a differential drive mobile robot", in Journal of Mech. Engr'g. Res. Dev., vol. 43, no. 7, pp. 255–269, 2020.
2. Muhammad, M., Bature, A. A., Zangina, U., Buyamin, S., Ahmad, A., Shamsudin, M. A, "Velocity control of a two-wheeled inverted pendulum mobile robot: A fuzzy model-based approach", in Bulletin of Electrical Engineering and Informatics, 8(3), 2019.

3. Abioye, A. E., Zainal Abidin, M. S., Azimi Mahmud, M. S., Buyamin, S., Zangina, U., "Performance Comparison of Experimental IoT Based Drip and Fibrous Capillary Irrigation Systems in The Cultivation of Cantaloupe Plants.", in Advances in Agricultural and Food Research Journal, 1(2), 2020.