Filippo Muzzini

Date of birth: 27/06/1993 | Place of birth: Castelnovo ne' Monti, Italy | Nationality: Italian | Phone: (+39) 0592055243 (Work) | Email address: filippo.muzzini@unimore.it | Address: via Campi 213, Modena, Italy (Work)

Work experience

Associate Researcher | University of Modena and Reggio Emilia | 01/07/2024 - Current | Modena, Italy

Docente Universitario | University of Modena and Reggio Emilia | 16/09/2024 - 19/09/2024 | Modena, Italy

Teacher of "Advanced GPU programming – libraries for data science" in the Computer and Data Science PhD course.

PostDoc researcher | University of Modena and Reggio Emilia | 16/03/2023 - 30/06/2024 | Modena, Italy

Docente universitario a contratto | University of Modena and Reggio Emilia | 25/09/2023 - 22/12/2023 | Modena, Italy

Teacher of "Programming complements" in the Computer Science course.

Docente universitario | University of Modena and Reggio Emilia | 05/09/2023 - 07/09/2023 | Modena, Italy

Teacher of "Advanced GPU programming – libraries for data science" the Computer and Data Science PhD course.

Software developer | ICT-Group Srl | 27/01/2019 - 30/10/2019 | Reggio Emilia, Italy

Education & Training

PhD in Mathematics | University of Parma | 01/11/2019 - 31/01/2023

Phd between University of Parma and University of Modena and Reggio Emilia.

Thesis in Computer Science: "Control, Perception and Coordination algorithms for Advanced Driver-Assistance System: optimized implementations and simulations"

International Summer School on Advanced Computer Architecture and Compilation (ACACES) | Hipeac | 10/07/2022 - 16/07/2022

Master Degree | University of Modena and Reggio Emilia | 31/07/2016 - 30/11/2018 | Modena, Italy

Final grade: 110 cum Laude | **Thesis:** Urban traffic simulation in smart cities

Bachelor Degree | University of Modena and Reggio Emilia | 31/07/2013 - 30/11/2016 | Modena, Italy

High School Degree | Liceo Dall'Aglio | 31/07/2006 - 30/06/2012 | Castelnovo ne' Monti (RE), Italy

Publications

Interactive Optimization of Scaffolded Procedural Patterns

Sforza, D., Riso, M., Muzzini, F., Capodieci, N., & Pellacini, F. (2025). Sforza, Davide, et al. "Interactive Optimization of Scaffolded Procedural Patterns." Proceedings of the Special Interest Group on Computer Graphics and Interactive Techniques Conference Conference Papers. 2025. SIGRAPH

A procedural program is the representation of a family of assets that share the same structural or semantic properties, whose final appearance is determined by different parameter assignments. Identifying the parameter values that define a desired asset is usually a time-consuming operation, since it requires manually tuning parameters separately and in a non-intuitive manner. In the domain of procedural patterns, recent works focused on estimating parameter values to match a target render or sketch, using parameter optimization or inference via neural networks. However, these approaches are neither fast enough for interactive design nor precise enough to give

direct control. In this work, we propose an interactive method for procedural parameter estimation based on the idea of scaffolded procedural patterns. A scaffolded procedural pattern is a sequence of procedural programs that model a pattern in a coarse-to-fine manner, in which the desired pattern appearance is reached step-by-step by inheriting previously optimized parameters. Through scaffolding, patterns are more straightforward to sketch for users and easier to optimize for most algorithms. In our implementation, patterns are represented as procedural signed distance functions whose parameters are estimated with a gradient-free optimization method that runs in real-time on the GPU. We show that scaffolded patterns can be created with a node-based interface familiar to artists. We validate our approach by creating and interactively editing several scaffolded patterns. We show the effectiveness of scaffolding through a user study, where scaffolding enhances both the output quality and the editing experience with respect to approaches that optimize the procedural parameters all at once. We also perform a comparison with previous strategies and provide several recordings of real-time editing sessions in the accompanying materials.

https://dl.acm.org/doi/full/10.1145/3721238.3730667

Integrating Smart Traffic Lights for Enhanced Urban Air Quality in Smart Cities

2024. Cabri, G., Ciccia, D., Montangero, M., & Muzzini, F. (2024, December). Integrating Smart Traffic Lights for Enhanced Urban Air Quality in Smart Cities. In 2024 IEEE/ACM Symposium on Edge Computing (SEC) (pp. 358-363). IEEE.

In recent years, Smart Cities have become a focal point for integrating advanced technologies and intelligent systems to create sustainable urban environments. A key issue in these cities is reducing emissions, and smart traffic lights have emerged as an important tool in addressing this challenge. This work builds on a previously proposed system designed to reduce pollution through smart traffic lights, which was initially limited to three-way intersections and tested on a single traffic signal. We extend the system to manage various types of signalized intersections and evaluate its performance across multiple intersections in a city. Our findings show that smart traffic lights can reduce pollution even without coordination between traffic lights and vehicles.

https://ieeexplore.ieee.org/abstract/document/10818020/

GPU implementation of the Frenet Path Planner for embedded autonomous systems: A case study in the F1tenth scenario

2024. Muzzini, F., Capodieci, N., Ramanzin, F., & Burgio, P. (2024). GPU implementation of the Frenet Path Planner for embedded autonomous systems: A case study in the F1tenth scenario. Journal of Systems Architecture, 154, 103239.

Autonomous vehicles are increasingly utilized in safety-critical and time-sensitive settings like urban environments and competitive racing. Planning maneuvers ahead is pivotal in these scenarios, where the onboard compute platform determines the vehicle’s future actions. This paper introduces an optimized implementation of the Frenet Path Planner, a renowned path planning algorithm, accelerated through GPU processing. Unlike existing methods, our approach expedites the entire algorithm, encompassing path generation and collision avoidance. We gauge the execution time of our implementation, showcasing significant enhancements over the CPU baseline (up to 22x of speedup). Furthermore, we assess the influence of different precision types (double, float, half) on trajectory accuracy, probing the balance between completion speed and computational precision. Moreover, we analyzed the impact on the execution time caused by the use of Nvidia Unified Memory and by the interference caused by other processes running on the same system. We also evaluate our implementation using the F1tenth simulator and in a real race scenario. The results position our implementation as a strong candidate for the new state-of-the-art implementation for the Frenet Path Planner algorithm.

https://www.sciencedirect.com/science/article/pii/S1383762124001760

Emergency Vehicles in the Smart Cities: Challenges and Enabling Technologies

2024. Scribano, C., & Muzzini, F. (2024, June). Emergency Vehicles in the Smart Cities: Challenges and Enabling Technologies. In 2024 IEEE Symposium on Computers and Communications (ISCC) (pp. 1-6). IEEE.

Scrivi qui la descrizione...Smart cities’ infrastructures offer several opportunities to increase cities’ livability. One of these is the chance to improve Emergency Vehicles’ response time. Reducing Emergency Vehicles’ response time can save lives and reduce congestion in traffic flow. On the other hand, the response time can be affected by uncontrolled traffic situations. Smart city’s capabilities can be exploited to manage traffic conditions to reduce response time, but it is not a trivial task. In this work, we analyze the challenges that must be considered in the design of traffic management systems and we show the enabling technologies able to sense traffic status and provide the necessary information to the traffic management system.

https://ieeexplore.ieee.org/abstract/document/10733681/

High-Performance Feature Extraction for GPU-accelerated ORB-SLAMx

2024.

F. Muzzini, N. Capodieci, R. Cavicchioli, B. Rouxel. High-Performance Feature Extraction for GPU-accelerated ORB-SLAMx. Accettato a DATE24. To appear

GGS Rating: A

In the autonomous vehicles field, localization is a crucial aspect. While the ORB-SLAM algorithm is a recognized solution for these tasks, it poses challenges due to its computational intensity.

Although accelerated implementation exists, a bottleneck persists in the Point Filtering phase which relies on the Distribute Octree algorithm that is not suitable for GPU processing.

In this paper, we introduce a novel GPU-suitable algorithm designed to enhance the Point Filtering step, surpassing Distribute Octree. We conducted a comprehensive comparison with state-of-the-art CPU and GPU implementations, considering both computational time and trajectory accuracy. Our experimental results, demonstrate significant speed-ups up to 3x compared to previous contributions.

https://www.date-conference.com/date-2024-accepted-papers

Exploiting Traffic Light Coordination and Auctions for Intersection and Emergency Vehicle Management in a Smart City Mixed Scenario

2024.

Muzzini F, Montangero M. Exploiting Traffic Light Coordination and Auctions for Intersection and Emergency Vehicle Management in a Smart City Mixed Scenario. Sensors. 2024; 24(7):2036.

Scimagojr Ratings: Q2 Computer Science - Information Systems

IoT (Internet-of-Things)-powered devices can be exploited to connect vehicles to smart city infrastructure, allowing vehicles to share their intentions while retrieving contextual information about diverse aspects of urban viability. In this paper, we place ourselves in a transient scenario in which next-generation vehicles that are able to communicate with the surrounding infrastructure coexist with traditional vehicles with limited or absent IoT capabilities. We focus on intersection management, in particular on reusing existing traffic lights empowered by a new management system. We propose an auction-based system in which traffic lights are able to exchange contextual information with vehicles and other nearby traffic lights with the aim of reducing average waiting times at intersections and consequently overall trip times. We use bid propagation to improve standard vehicle trip times while allowing emergency vehicles to free up the way ahead without needing ad hoc system for such vehicle, only an increase in their budget. The proposed system is then tested against two baselines: the classical Fixed Time Control system currently adopted for traffic lights, and an auction strategy that does not exploit traffic light coordination. We performed a large set of experiments using the well known MATSim transport simulator on both a synthetic Manhattan map and on a map we built of an urban area located in Modena, Northern Italy. Our results show that the proposed approach performs better than the classical fixed time control system and the auction strategy that does not exploit coordination among traffic lights.

https://www.mdpi.com/1424-8220/24/7/2036

Learn to Bet: Using Reinforcement Learning to Improve Vehicle Bids in Auction-Based Smart Intersections

2024.

Cabri G, Lugli M, Montangero M, Muzzini F. Learn to Bet: Using Reinforcement Learning to Improve Vehicle Bids in Auction-Based Smart Intersections. Sensors. 2024; 24(4):1288.

Scimagojr Ratings: Q2 Computer Science - Information Systems

With the advent of IoT, cities will soon be populated by autonomous vehicles and managed by intelligent systems capable of actively interacting with city infrastructures and vehicles. In this work, we propose a model based on reinforcement learning that teaches to autonomous connected vehicles how to save resources while navigating in such an environment. In particular, we focus on budget savings in the context of auction-based intersection management systems. We trained several models with Deep Q-learning by varying traffic conditions to find the most performance-effective variant in terms of the trade-off between saved currency and trip times. Afterward, we compared the performance of our model with previously proposed and random strategies, even under adverse traffic

conditions. Our model appears to be robust and manages to save a considerable amount of currency without significantly increasing the waiting time in traffic. For example, the learner bidder saves at least 20% of its budget with heavy traffic conditions and up to 74% in lighter traffic with respect to a standard bidder, and around three times the saving of a random bidder. The results and discussion suggest practical adoption of the proposal in a foreseen future real-life scenario.

https://www.mdpi.com/1424-8220/24/4/1288

Smart Parking for All: Equipped and Non-equipped Vehicles in Smart Cities

2023.

Muzzini, F., Montangero, M., & Capodieci, N. (2022, September). Smart Parking for All: Equipped and Non-equipped Vehicles in Smart Cities. In International Symposium on Intelligent and Distributed Computing (pp. 257-266). Bremen, Germany, 2022. Cham: Springer International Publishing.

The current trend in designing cities is to think them as smart environments that are constantly connected with road users. For this purpose, a smart city is implemented as a collection of IoT (Internet-of-Things) powered devices set up in order to connect vehicles to their surrounding infrastructure. In this way, road users share their intentions while retrieving useful information from the smart city itself. This complex and distributed system must be then tailored to improve viability performance metrics such as reducing traffic congestion, optimizing accident response and everything else related to transportation in urban areas. In this work we focus on parking management in a scenario in which next generation vehicles will be able to communicate with the surrounding infrastructure and will coexist with traditional vehicles with limited or absent IoT-capabilities. We propose a reservation mechanism able to exploit communication at infrastructure level, with the goal of reducing the time needed to find a free parking spot close to destination. We evaluate our proposed mechanisms using the well known MATSim transport simulator.

https://link.springer.com/chapter/10.1007/978-3-031-29104-3_28

Optimized Local Path Planner Implementation for GPU-Accelerated Embedded Systems

2023. IEEE Embedded Systems Letters.

F. Muzzini, N. Capodieci, F. Ramanzin and P. Burgio. Optimized Local Path Planner Implementation for GPU-Accelerated Embedded Systems. In IEEE Embedded Systems Letters, vol. 15, no. 4, pp. 214-217, Dec. 2023

Scimagojr Ratings: Q2 Computer Science - Miscellaneous, Q3 Engineering - Control and Systems Engineering

Autonomous vehicles are latency-sensitive systems. The planning phase is a critical component of such systems, during which the in-vehicle compute platform is responsible for determining the future maneuvers that the vehicle will follow. In this paper, we present a GPU-accelerated optimized implementation of the Frenet Path Planner, a widely known path planning algorithm. Unlike the current state-of-the-art, our implementation accelerates the entire algorithm, including the path generation and collision avoidance phases. We measure the execution time of our implementation and demonstrate dramatic speedups compared to the CPU baseline implementation. Additionally, we evaluate the impact of different precision types (double, float, half) on trajectory errors to investigate the tradeoff between completion latencies and computation precision.

https://ieeexplore.ieee.org/abstract/document/10194312

Brief Announcement: Optimized GPU-accelerated Feature Extraction for ORB-SLAM Systems

2023. SPAA '23: Proceedings of the 35th ACM Symposium on Parallelism in Algorithms and Architectures.

Filippo Muzzini, Nicola Capodieci, Roberto Cavicchioli, and Benjamin Rouxel. 2023. Brief Announcement: Optimized GPU-accelerated Feature Extraction for ORB-SLAM Systems. In Proceedings of the 35th ACM Symposium on Parallelism in Algorithms and Architectures (SPAA '23), Orlando, FL, USA, 2023. Association for Computing Machinery, New York, NY, USA, 299–302.

GGS Rating: A

Reducing the execution time of ORB-SLAM algorithm is a crucial aspect of autonomous vehicles since it is computationally intensive for embedded boards. We propose a parallel GPU-based implementation, able to run on embedded boards, of the Tracking part of the ORB-SLAM2/3 algorithm. Our implementation is not simply a GPU port of the tracking phase. Instead, we propose a novel method to accelerate image Pyramid construction on GPUs. Comparison against state-of-the-art CPU and GPU implementations, considering both computational time and trajectory errors shows improvement on execution time in well-known datasets, such as KITTI and EuRoC.

https://dl.acm.org/doi/abs/10.1145/3558481.3591310

Coordinated traffic lights and auction intersection management in a mixed scenario

2023.

Filippo Muzzini, Nicola Capodieci, and Manuela Montangero. 2023. Coordinated traffic lights and auction intersection management in a mixed scenario. In Proceedings of the 2023 ACM Conference on Information Technology for Social Good (GoodIT '23). Lisbon, Portugal, 2023. Association for Computing Machinery, New York, NY, USA, 1.

IoT (Internet-of-Things) powered devices can be exploited to connect vehicles to a smart city infrastructure and thus allow vehicles to share their intentions while retrieving contextual information about diverse aspects of urban viability. Such a complex system is aimed at improving our way of living in the city by mitigating the effect of traffic congestion, and consequently stress and pollution. We place ourselves in a transient scenario in which next generation vehicles that are able to communicate with the surrounding infrastructure coexist with traditional vehicles with limited or absent IoT-capabilities. In this work we focus on intersection management and, in particular, on reusing existing traffic lights empowered by a new management systems. We propose an auction based system in which traffic lights are able to exchange contextual information with vehicles and the nearby traffic lights with the aim of reducing average waiting times at intersections and consequently, overall trip times. We evaluate our proposal using the well known MATSim transport simulator, by using a synthetic Manhattan map and a new map we build on an urban area located in our town, in Norther Italy. In such an area, instrumentation through IoT devices has been set up as part of an European research project. Results show that the proposal is better performing than the classical Fixed Time Control system currently adopted for traffic lights, and then auction strategies that do not exploit coordination among nearby traffic lights.

https://dl.acm.org/doi/10.1145/3582515.3609534

Improving urban viability through smart parking

2023.

Filippo Muzzini, Nicola Capodieci & Manuela Montangero(2023). Improving urban viability through smart parking. International Journal of Parallel, Emergent and Distributed Systems,38:6,522-540.

Scimagojr Ratings: Q3 Computer Science - Computer Networks and Communications, Q4 Computer Science - Software

In Smart Cities, vehicles can share intentions and retrieve information through IoT (Internet-of-Things) devices. This work proposes a reservation system that exploits communication between vehicles and city infrastructure to reduce the time a road user needs to find parking. The system is designed to manage the coexistence of next-generation vehicles, that communicate with city infrastructure and traditional vehicles that don't. We reconstructed an IoT-instrumented urban area using the MATSim simulator to evaluate the system. The proposed system reduces the parking search time of next-generation vehicles without disadvantaging traditional vehicles, making it a candidate for scenarios where both vehicle types coexist.

https://www.tandfonline.com/doi/abs/10.1080/17445760.2023.2246166

About auction strategies for intersection management when human-driven and autonomous vehicles coexist

2021.

Cabri, G., Gherardini, L., Montangero, M., & Muzzini, F. (2021). About auction strategies for intersection management when human-driven and autonomous vehicles coexist. Multimedia Tools and Applications, 80, 15921-15936.

Scimagojr ratings: Q2 Computer Science Computer Networks and Communications / Hardware and Architecture Software, Q1 Engineering - Media Technology

Autonomous vehicles are appearing in our streets, and will soon populate our transportation infrastructures, which must be equipped with appropriate sensors and actuators in order to manage vehicles in a fruitful way. Besides the infrastructures, appropriate algorithms must be defined in order to coordinate the vehicles and to enable them to exploit the resources in a fair yet effective way. In the immediate future, autonomous vehicles must coexist human-driven vehicles, and this transitory scenario poses several challenges in coordinating both kinds to exploit street resources. One of these resources, whose management is quite challenging, is represented by intersections: vehicles come and aim at passing the intersection, often as soon as possible, but they must compete with other

vehicles having the same aim. A possible approach that has been used in literature to this problem uses auction based mechanisms. In this paper, we place ourselves in the above-mentioned transitory scenario in which both human-driven and autonomous vehicles will compete to cross intersections, and we investigate the effectiveness of auction-based mechanism to coordinate vehicles at intersections. We devise some simple auction policies, and assume vehicle coordination strategies that are suitable also for human drivers. Our results lead us to believe that, under these assumptions, simple auction mechanisms do not introduce advantages for what concern traveling times as they do in the case of exclusively autonomous vehicles.

https://link.springer.com/article/10.1007/s11042-020-10222-y

Improving emergency response in the era of ADAS vehicles in the Smart City

2021. ICT Express.

Capodieci, N., Cavicchioli, R., Muzzini, F., & Montagna, L. (2021). Improving emergency response in the era of ADAS vehicles in the Smart City. ICT Express, 7(4), 481-486.

Scimagojr Ratings: Q1 Computer Science - Artificial Intelligence / Computer Networks and Communications / Hardware and Architecture / Information Systems / Software

Management of emergency vehicles can be fostered within a Smart City, i.e. an urban environment in which many IoT devices are orchestrated by a distributed intelligence able to suggest to road users the best course of action in different traffic situations. By extending MATSim (Multi-Agent Transport Simulation Software), we design and test appropriate mitigation strategies when traffic accidents occur within an existing urban area augmented with V2V (Vehicle-to-Vehicle), V2I (Vehicle-to-Infrastructure) capabilities and Advanced Driving Assisted cars (ADAS). Further, we propose traffic congestion models and related mechanisms for improving the necessary time for emergency vehicles to respond to accidents.

https://www.sciencedirect.com/science/article/pii/S2405959521000382

Exploiting Traffic Lights to Manage Auction-Based Crossings

2020.

F. Muzzini, N. Capodieci, and M. Montangero. 2020. Exploiting Traffic Lights to Manage Auction-Based Crossings. In Proceedings of the 6th EAI International Conference on Smart Objects and Technologies for Social Good (GoodTechs '20). Antwerp, Belgium, 2020, pp. 199–204.

Auction-based crossing management approaches are used to design coordination policies for autonomous vehicles and improve smart intersections by providing differentiated latencies. In this paper, we propose and exploit an auction based mechanism for managing the urban traffic light infrastructure in which participant vehicles are either equipped or non-equipped. The difference between these two categories of vehicles is that only the equipped ones can actively participate to auctions through in-vehicle IoT-devices, i.e. they are able to communicate with the surrounding urban infrastructure. In this way, we aim to study the transitional period that will occur before the complete adoption of autonomous or strongly connected vehicles. Through extensive experiments and simulations, by comparing our mechanism to the traditional traffic light fixed-time-control approach, we studied the benefits and limitations, in term of waiting and trip times, when varying the subset of equipped vehicles and the available budget that can be used to participate to auctions.

https://dl.acm.org/doi/abs/10.1145/3411170.3411257

Managing human-driven and autonomous vehicles at smart intersections

2020.

G. Cabri, M. Montangero, F. Muzzini and P. Valente. 2020. Managing human-driven and autonomous vehicles at smart intersections. IEEE International Conference on Human-Machine Systems (ICHMS), Rome, Italy, 2020, pp. 1-4.

Auction-based crossing management approaches are used to design coordination policies for autonomous vehicles and improve smart intersections by providing for differentiated latencies. In this paper we exploit auction-based mechanisms to design a management intersections system re-using traffic lights and coordinating human driven and autonomous vehicles. We first describe in detail this system that uses already present traffic lights and the bidding policy of our auction mechanisms. We then describe our experimental scenario and the research issue that will be addressed by means of future simulations.

https://ieeexplore.ieee.org/abstract/document/9209348

Conferences & Seminars

10th Italian Workshop on Embedded Systems | 18/10/2025 - Current | Modena

Session Chair

International Workshop on Smart Moving organized within the ACM/IEEE Symposium on Edge Computing | 07/12/2024 - Current | Roma - Italia

Paper: Integrating Smart Traffic Lights for Enhanced Urban Air Quality in Smart Cities

Design, Automation and Test in Europe Conference 2024 - DATE24 | 25/03/2024 - Current | Valencia (Spagna)

Paper: "High-Performance Feature Extraction for GPU-accelerated ORB-SLAMx"

GGS Rating: A

EMSOFT 2023: International Conference on Embedded Software | 18/09/2023 - Current | Amburgo (Germania)

Paper: "Optimized Local Path Planner implementation for GPU-accelerated embedded systems"

GGS Collected Classes: A, A-, NC

35th ACM Symposium on Parallelism in Algorithms and Architectures (SPAA '23) | 16/06/2023 - Current | Orlando (Florida - USA)

Paper: "Brief Announcement: Optimized GPU-accelerated Feature Extraction for ORB-SLAM

Systems"

GGS Rating: A

IEEE International Conference on Robotics and Automation 2023 - ICRA | 29/05/2023 - Current | Londra, Regno Unito

"F1/10" Competition.

Intelligent Distributed Computing Symposium 2022 - IDC | 14/09/2022 - Current | Brema (Germania) (Online)

Paper: "Smart Parking for all: equipped and non-equipped vehicles in smart cities"

Euromicro Conference on Real-Time Systems 2022 - ECRTS | 05/07/2022 - Current | Modena

Organization

Seminar - Computer Science and disclosure | 19/11/2021 - Current | Modena

Brain-Inspired Computing Workshop | 07/10/2021 - Current | Modena

6th EAI International Conference on Smart Objects and Technologies for Social Good - GoodTechs | 13/09/2020 - Current | Online (causa Covid)

Presenting the Paper: "Exploiting Traffic Lights to Manage Auction-Based Crossings"

Seminar- Java Programming in MATSim | 27/11/2020 - Current | Modena

Seminar inside the course of "Object Oriented Programming"

1st IEEE International Conference on Human-Machine Systems - ICHMS | 06/09/2020 - Current | Roma (Online due Covid)

Presentazione del Paper: "Managing human-driven and autonomous vehicles at smart intersections"

Projects

H2020 IMOCO4.E | 01/01/2022 - 31/12/2024

PS-DDS | 01/09/2023 - 29/02/2024

H2020 CLASS | 01/11/2019 - 30/06/2021

FRAMING EMPLOYEE ATTITUDES AND DIGITAL WORK BEHAVIORS | 01/02/2019 - 31/07/2019

Awards

BEST PAPER AWARD – ACM 3rd International Conference on Information Technology for Social Good (GoodIT 2023) | 08/09/2023 - 08/09/2023

Modena, 14/11/2025

Filippo Muzzini