

REGULAR PAPER

Analysis of the traffic conflict situation for speed probability distributions

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Abstract

The increasingly widespread application of drones and the emergence of urban air mobility leads to a challenging question in airspace modernisation: how to create a safe and scalable air traffic management system that can handle the expected density of operations. Increasing the number of vehicles in a given airspace volume and enabling routine operations are essential for these services to be economically viable. However, a higher density of operations increases risks, poses a great challenge for coordination and necessitates the development of a novel solution for traffic management. This paper contributes to the research towards such a strategy and the field of airspace management by calculating and analysing the conflict probability in an en-route, free-flight scenario for autonomous vehicles. Analytical methods are used to determine the directional dependence of conflict probabilities for exponential and normal prescribed speed probability distributions. The notions of geometric and speed conflict are introduced and distinguished throughout the calculations of the paper. The effect of truncating the set of available flight speeds is also investigated. The sensitivity of the calculated results to speed and heading perturbations is studied within the analytical framework and verified by numerical simulations. Results enable a fresh approach to conflict detection and resolution through distribution shaping and are intended to be used in an integrated, stochastic coordination framework.

Nomenclature

a	parameter of the exponential distribution for the ownship [—]
ACAS	airborne collision avoidance system
ADS-B	automatic dependent surveillance-broadcast
ATC	air traffic control
b	parameter of the exponential distribution for the intruder [—]
CA	collision avoidance
CNS	communication, navigation and surveillance
d	distance to be traversed between sensing range and conflict range ^(m)
DAA	detect and avoid
erfc	complementary error function
GC	geometric conflict
l	lower speed limit [Kn]
MDP	Markov decision process
NMAC	near mid-air collision
p	magnitude of normal distribution variables [—]
PAV	personal aerial vehicle
PDF	probability density function
$\Pr(x)$	probability of x

Analysis Of Traffic Conflict Collision

**Hugh W. McGee, National Cooperative
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Analysis Of Traffic Conflict Collision:

International Calibration Study of Traffic Conflict Techniques E. Asmussen, 2012-12-06 The concept of traffic conflict was initiated in the United States in the 60s and raised a lot of interest in many countries it was an opening towards the development of a new tool for safety evaluation and the diagnosis of local safety problems The need for such a tool was great because of the many situations where accident data was either scarce unsatisfactory or unavailable Development of Traffic Conflict Techniques TCT started simultaneously in the 70s in several European countries and new studies were also undertaken in the United States Canada and Israel The need for international cooperation was rapidly felt in order to exchange data compare definitions and check progresses An Association for International Cooperation on Traffic Conflict Techniques ICTCT was therefore created grouping researchers and safety administrators with the aim of promoting and organising exchange of information and common practical work Three Traffic Conflict Techniques Workshops were organised in Oslo 1977 Paris 1979 and Leidschendam 1982 A small scale international experiment of calibration of TCTs was also carried out in Rouen France in 1979 and five teams took part in it from France Germany Sweden the United Kingdom and the United States results of this first experiment were used as a basis for the present enterprise To be acknowledged as a safety measuring tool traffic conflict techniques had to be validated in relation to traditional safety indicators such as injury accidents

Measuring Road Safety with Surrogate Events Andrew Tarko, 2019-11-05 Measuring Road Safety Using Surrogate Events provides researchers and practitioners with the tools they need to quickly and effectively measure traffic safety As traditional crash based safety analyses are being undermined by today's growing use of intelligent vehicular and road safety technologies crash surrogates or near misses can be more effectively used to measure the future risk of crashes This book advances the idea of using these near crash techniques to deliver quicker and more adequate measurements of safety It explores the relationships between traffic conflicts and crashes using an extrapolation of observed events rather than post crash data which is significantly slower to obtain Readers will find sound estimation methods based on rigorous scientific principles offering compelling new tools to better equip researchers to understand road safety and its factors

Traffic Engineering Handbook ITE (Institute of Transportation Engineers), Brian Wolshon, Anurag Pande, 2016-01-26 Get a complete look into modern traffic engineering solutions Traffic Engineering Handbook Seventh Edition is a newly revised text that builds upon the reputation as the go to source of essential traffic engineering solutions that this book has maintained for the past 70 years The updated content reflects changes in key industry standards and shines a spotlight on the needs of all users the design of context sensitive roadways and the development of more sustainable transportation solutions Additionally this resource features a new organizational structure that promotes a more functionally driven multimodal approach to planning designing and implementing transportation solutions A branch of civil engineering traffic engineering concerns the safe and efficient movement of people and goods along roadways Traffic flow road geometry

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Characterization, Mechanisms, Simulation, and Modeling Imad L. Al-Qadi,Tarek Sayed,Naser Alnuaimi,Eyad Masad,2008-11-01 Internationally significant attention is given to transport sustainability including planning design construction evaluation safety and durability of the road system The 4th International Gulf Conference on Roads Efficient Transportation and Pavement Systems Characterization Mechanisms Simulation and Modeling hosted by the University o

Crash Experience Warrant for Traffic Signals Hugh W. McGee,National Cooperative Highway Research Program,2003 Safe Mobility Dominique Lord,Simon Washington,2018-04-18 This book increases the level of knowledge on road safety contexts issues and challenges shares what can currently be done to address the variety of issues and points to what needs to be done to make further gains in road safety *Accident Risk Forecasting; a Bibliography* Lois Flynn,1977

Proceedings of the 7th International Conference of Transportation Research Group of India (CTRG 2023), Volume 3 Prasanta K. Sahu,Amit Agarwal,Ankit Kathuria,Nagendra R. Velaga,2025-02-26 This book presents select proceedings of the 7th Conference of Transportation Research Group of India 7th CTRG 2023 provides an opportunity for discussion of state of the art research and practice in the developing world for achieving equitable efficient and resilient infrastructure and opens pathways to sustainable transportation This book covers the solutions related to transportation challenges such as road user safety traffic operation efficiency economic and social development non motorized transport planning environmental impact mitigation energy consumption reduction land use equity freight transport planning multimodal coordination access for the diverse range of mobility needs sustainable pavement construction and emerging vehicle technologies The information and data driven inferences compiled in this book are therefore expected to be useful for practitioners policymakers educators researchers and individual learners interested in sustainable transportation and allied fields Proceedings of the Sixth International Conference of Transportation Research Group of India Lelitha Devi,Madhu Errampalli,Avijit Maji,Gitakrishnan Ramadurai,2022-09-28 This book comprises the proceedings of the Sixth International Conference of Transportation

Research Group of India CTRG2021 focusing on emerging opportunities and challenges in the field of transportation of people and freight The contents of the volume include characterization of conventional and innovative pavement materials operational effects of road geometry user impact of multimodal transport projects spatial analysis of travel patterns socio economic impacts of transport projects analysis of transportation policy and planning for safety and security technology enabled models of mobility services etc This book will be beneficial to researchers educators practitioners and policy makers alike

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