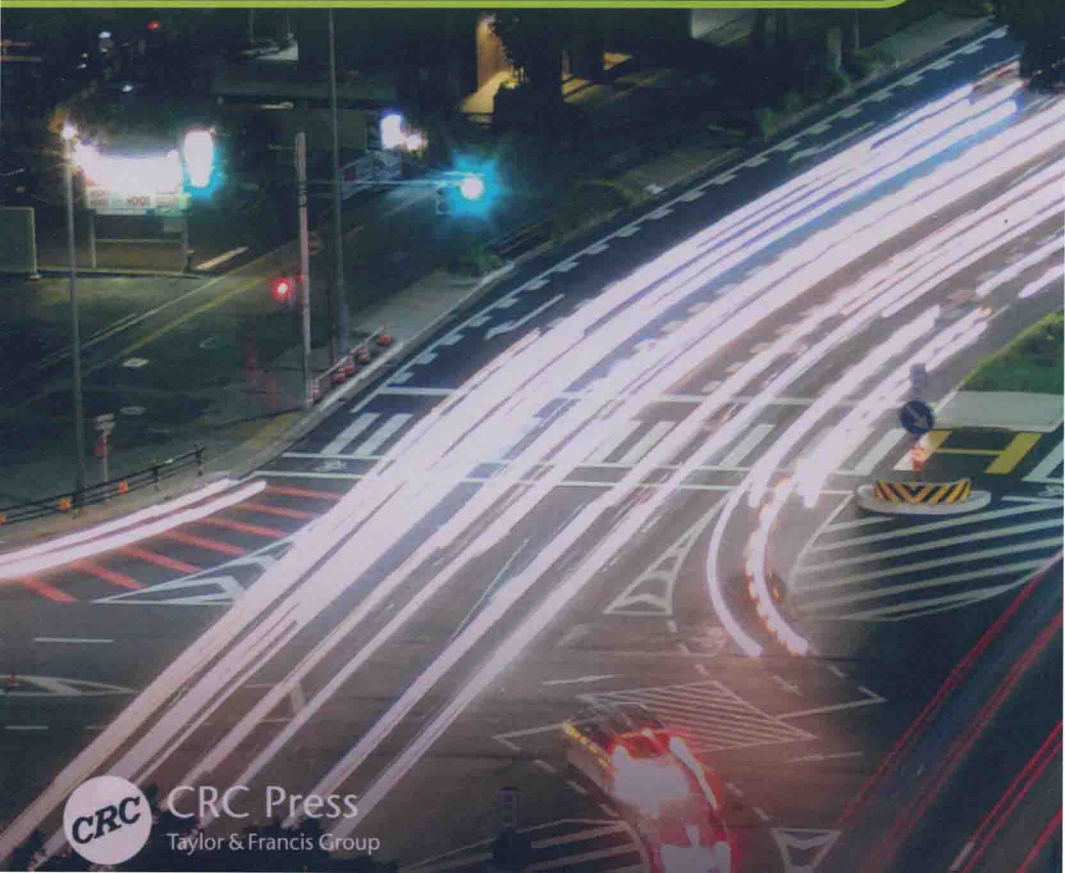


# Predicting Vehicle Trajectory

**Cesar Barrios • Yuichi Motai**



**CRC Press**  
Taylor & Francis Group

# Predicting Vehicle Trajectory

This book concentrates on improving the prediction of a vehicle's future trajectory, particularly on non-straight paths. Having an accurate prediction of where a vehicle is heading is crucial for the system to reliably determine possible path intersections of more than one vehicle at the same time. The US DOT will be mandating that all vehicle manufacturers begin implementing V2V and V2I systems, so very soon collision avoidance systems will no longer rely on line of sight sensors, but instead will be able to take into account another vehicle's spatial movements to determine if the future trajectories of the vehicles will intersect at the same time. Furthermore, the book introduces the reader to some improvements when predicting the future trajectory of a vehicle and presents a novel temporary solution on how to speed up the implementation of such V2V collision avoidance systems. Additionally, it evaluates whether smartphones can be used for trajectory predictions, in an attempt to populate a V2V collision avoidance system faster than a vehicle manufacturer can.

## Features

- MATLAB Code for proposed methods.
- Real Sensory Datasets (GPS, Accelerometer, ODBII, Scan-Tool) for download.
- Introduces the reader to some improvements when predicting the future trajectory of a vehicle, and presents a novel temporary solution on how to speed up the implementation of such V2V collision avoidance systems when only a small number of vehicles on the road will have this from the manufacturer.
- Discusses smartphone implementation.

K30633



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[www.crcpress.com](http://www.crcpress.com)

6000 Broken Sound Parkway, NW  
Suite 300, Boca Raton, FL 33487  
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New York, NY 10017  
2 Park Square, Milton Park  
Abingdon, Oxon OX14 4RN, UK

ISBN-13: 978-1-138-03019-0



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**Yuichi Motai**



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CRC Press  
Taylor & Francis Group  
6000 Broken Sound Parkway NW, Suite 300  
Boca Raton, FL 33487-2742

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Printed on acid-free paper

International Standard Book Number-13: 978-1-138-03019-0 (Hardback)

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**Library of Congress Cataloging-in-Publication Data**

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Names: Barrios, Cesar, author. | Motai, Yuichi, author.  
Title: Predicting vehicle trajectory / Cesar Barrios and Yuichi Motai.  
Description: Boca Raton : Taylor & Francis, a CRC title, part of the Taylor & Francis imprint, a member of the Taylor & Francis Group, the academic division of T&F Informa, plc [2017] | Includes bibliographical references and index.  
Identifiers: LCCN 2016043395 | ISBN 9781138030190 (hardback : acid-free paper) | ISBN 9781138031623 (ebook)  
Subjects: LCSH: Automobiles--Collision avoidance systems. | Trajectories (Mechanics)--Data processing. | Automotive computers.  
Classification: LCC TL272.52 .M68 2017 | DDC 629.2/042--dc23  
LC record available at <https://lccn.loc.gov/2016043395>

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# Predicting Vehicle Trajectory



*Prediction is very difficult, especially if it's about the future.*

—**Niels Bohr**, Nobel laureate in physics

*This book is dedicated to the love of my life, Raquel,  
for her unconditional encouragement.*

—**Cesar Barrios**

*I dedicate this book to my wife for her unlimited support.*

—**Yuichi Motai**



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# Preface

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Prediction of the trajectory path of a vehicle into the future is a difficult task, and even more so in non-straight paths, as observed in some of the research studied. Many times, the predicted future position of where the vehicle will be 3 s later in time falls outside of a physical road, making this prediction highly improbable. For the first part of this research, the assumption is made that the driven vehicle will remain on a road at all times, and any prediction that falls outside of a road will be considered incorrect. Through the use of a road-mapping technique, it will be shown that this error correction greatly reduces the prediction errors in non-straight paths.

Another problem observed when predicting a future position of a vehicle is that, when using multiple sensors, most of the time they are asynchronous. Some reviewed research describes a solution of running the system at the rate of its slowest sensor, and, therefore, solving the problem of asynchronous data. Other reviewed research uses previously estimated measurements to fill in the missing data from offline sensors. A vehicle is a large object that cannot change its spatial dynamics very quickly, but running a prediction system at a slow rate can slow down the detection of these spatial changes. For this research, the system is run at the rate of its fastest sensor, but missing measurements are calculated based on measurements obtained from online sensors using a dead-reckoning approach. A technique was developed to properly handle error accumulation from missing data from offline sensors, and that running the system at the fastest rate possible greatly reduces the prediction errors in non-straight paths.

The last part of this research looks into a possible solution to advance the usability of a vehicle-to-vehicle (V2V) system in its initial stages. The National Highway Safety Administration announced in 2014, its decision to begin taking the next steps toward implementing V2V technology in all new cars and trucks. Although all vehicle manufacturers are required to support this technology, it will still take many years until the V2V system is fully populated and most vehicles can participate. Until that point is reached, the benefits of the V2V technology will not be taken advantage of, unless a temporary solution is achieved to enable older vehicles to participate in the V2V system as well. Smartphones are readily available and already have many built-in sensors and good processing power, so in this part of the research, the possibility of using smartphones to predict the trajectory path of a vehicle will be used. It will be shown that some kinds of smartphones yield similar prediction errors as predictions calculated using vehicle-mounted sensors.

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## *Acknowledgments*

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Dr. Cesar Barrios' work was funded in part by the U.S. Department of Transportation through Lisa Aultman-Hall, director of the University of Vermont Transportation Research Center. Dr. Yuichi Motai received support from the National Science Foundation Grant #1054333.

The authors want to especially acknowledge Dr. Dryver Huston from the University of Vermont, and Dr. Adel Sadek from the University of Buffalo, for their invaluable comments on parts of this work and Dr. Walter Varhue, from the University of Vermont, for his contributions as the committee chairman.

The authors also acknowledge Dr. Eric Jackson for sharing some log files of data collected at the University of Connecticut, and Dr. Henry Himberg and Samuel Lopez for their comments on Kalman filters.



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