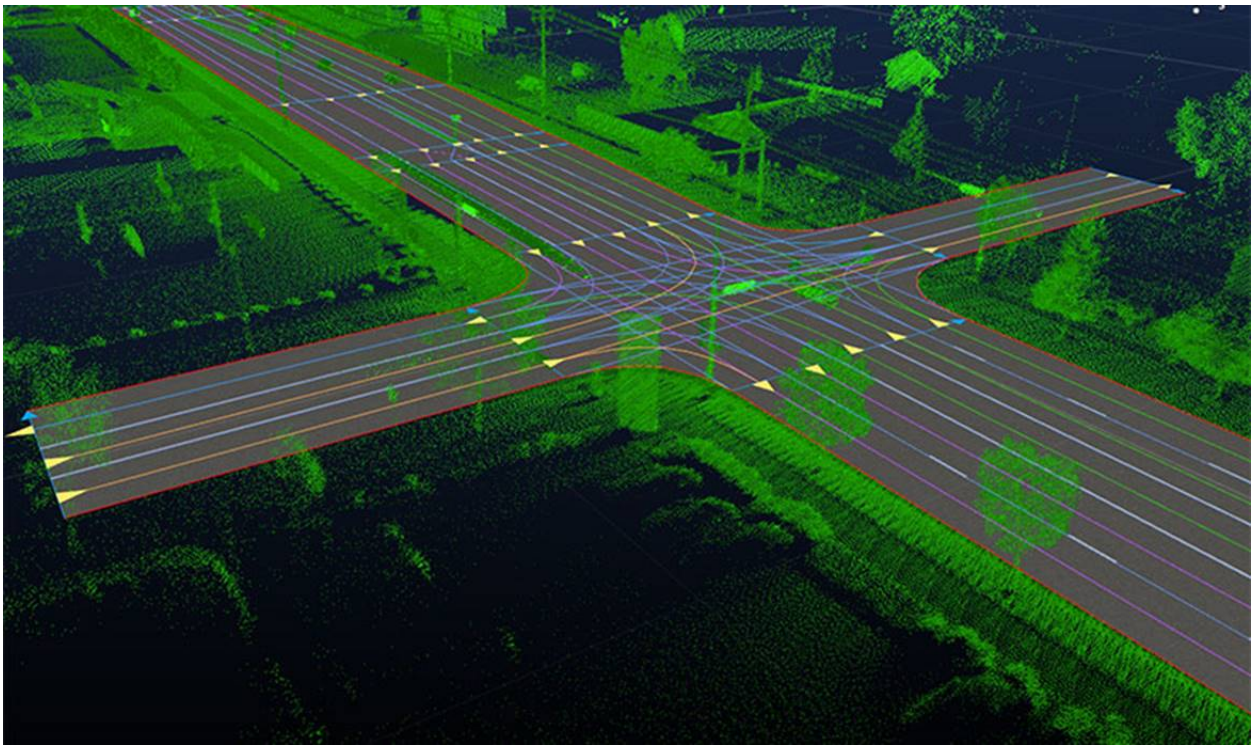
# ITS WC University Grand Challenge:
# Lane Level Localization on a 3D Map

# Call for Participation

## Introduction

The 23rd ITS World Congress will be held in Melbourne, Australia, 10-14 October 2016, under the banner of "ITS – Enhancing Liveable Cities and Communities". In advance of the event itself, the Congress calls universities world-wide to this University Grand Challenge, an opportunity to showcase contributions of academic research to one identified challenge in Intelligent Transportation Systems: Lane level localization on a 3D map. The best contributions to the University Grand Challenge will have an opportunity to present their solutions at the 23rd ITS World Congress.



## The Challenge

One of the biggest challenges of automated driving is to accurately determine the location of a vehicle relative to the roadway. Equipped with GPS, in-vehicle sensors (cameras), and a highly accurate 3D map, an automated driving system must be reliable, even under harsh conditions, due to GPS denial or imprecision, in-vehicle sensor malfunction, heavy occlusions, poor lighting,

and inclement weather. Lane level localization on a 3D map allows the vehicle to function reliably in such conditions.

To advance the technology and enable safer and more reliable automated driving, we present a grand challenge to localize a driving vehicle on a 3D map using the vehicle's GPS data and in-vehicle camera sensor data in real time.

## Problem Definition

A monocular video is acquired from a forward-facing camera mounted on top of a vehicle. The video was recorded while the vehicle was driving on a real access-controlled road (highway) in reasonable traffic conditions. A GPS position is given for each video frame. A 3D map is provided for the section of road driven by the vehicle during the acquisition.

The problem is to localize the vehicle at the correct lane and longitudinal position (a high resolution "mile marker") on the 3D map in real time. A possible solution is to detect objects from the video frames and match them to the objects in the 3D map to derive the lane level location.

## Data Collection

We collected the above input data on a highway in San Francisco with the following properties:

(1) Reasonable traffic
(2) Multiple lane highway
(3) Reasonable weather conditions
(4) The road markings are in good condition
(5) Data was collected over 20km. We will provide 10km of the data to participants to develop their algorithms, and the remainder will be used for evaluation. Ground truth data of camera locations will be provided for the training set.
(6) The car makes reasonably frequent lane changes during the collection

## Input

1. Images - these images are acquired with a commercial webcam mounted on top of a car and have the following properties:

    a. 10 HZ
    b. RGB color, 800 x 600 resolution

2. GPS data - a set of consumer phone grade GPS points with time stamp synchronized with the image timestamp

3. 3D map for the driven road segment including:
    a. Road and lane boundaries (including the boundary type e.g., road edge, solid marking, dashed marking)
    b. Marking colour (white or yellow)
    c. Elevated objects in voxels near the roadway
    d. Traffic sign location and text content

4. Camera calibration parameters

Details are included in README of the test data to be downloaded

## Output

1. An executable program with proper documentation so that when it runs on the evaluation dataset in the same format as the published test data it will output a spread sheet where each row lists “Image ID”, “latitude”, “longitude”. The “latitude” and “longitude” specify the location of the camera when the image with the “Image ID” was taken.
2. A technical paper describing the algorithm (pdf).

## Evaluation Criteria

(1) Lane accuracy
(2) Longitudinal accuracy
(3) Run Time of Execution

## Judgment Process

HERE will test the submissions using the evaluation dataset and report to a panel (60%). The panel will also evaluate the originality of the approach (20%) and the quality of the report (20%). All submissions will be ranked, and the participants will be informed about their rank. The top three will be awarded.

At the ITS World Congress 2016 the participants will have an opportunity to present their solutions in demonstrations and in plenum.

## Advisory Committee

The University Grand Challenge will be overseen by an independent advisory committee from academia and industry.

Co-Chairs:

- Stephan Winter, The University of Melbourne, Australia
- Xin Chen, HERE, USA

Committee members:

- Ryan Eustice, University of Michigan, USA
- Feng Guo, Qualcomm, USA
- Xianpeng Lang, Baidu, China
- Bharat Lohani, IIT Kanpur, India
- Kai Ni, Letv Super Car, China
- Monika Sester, Leibniz University Hannover, Germany
- Mark Tabb, HERE, USA
- Andreas Wendel, Google, USA
- Jianxiong Xiao, Princeton University, USA
- Alper Yilmaz, Ohio State University, USA
- Wende Zhang, General Motors, USA

## Registration

Individuals and groups from universities are invited to participate. Please use the form available on the Grand Challenge homepage to register and download the data:

http://conference.eng.unimelb.edu.au/its-gc/

## Timeline

- Submission deadline: 15 July 2016

- Challenge outcome notification: 15 August 2016

## Submission process

When you are ready to submit request your private submission depository from Maria Vasardani (mvasardani 'at' unimelb.edu.au). Once you have been provided with a link and password you can upload your program, any documentation and your paper by the submission deadline. All submissions will be assessed using an independent dataset, and ranked. You will be informed about the ranking of your submission.

## Awards

The participants passing the assessment will be given the opportunity to present their solutions to the Congress in an interactive session. It should be noted that congress registration is required for the presentation, and participants should complete their registration early via the congress website (http://www.itsworldcongress2016.com). A discounted student registration rate is available for those who are eligible.

Winners will be recognized in the closing session of the Congress.

Awards for the best submission and the runner-ups: to be announced soon.

## Sponsors

tba.

## Contact

For any questions regarding the dataset, please contact **Xin Chen** (xin.5.chen 'at' here.com).

For organizational questions (registration, submission or notification) contact **Maria Vasardani** (mvasardani 'at' unimelb.edu.au).

Any question regarding the conduct of the University Grand Challenge, including media requests, can be directed to **Stephan Winter** (winter 'at' unimelb.edu.au).