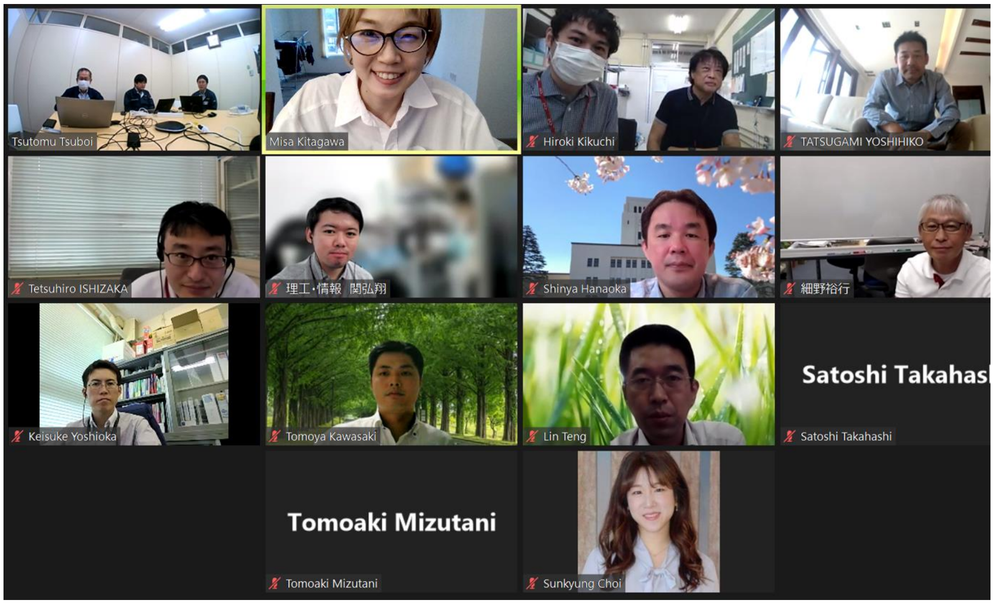


SATREPS general meeting on 27th Sep

M2Smart NewsLetter

Vol.13

Oct 2021

OVERALL SUMMARY & SPECIAL TOPICS

After intermittent hiatus, the phase of full-scale re-start has come!

Overall Summary

by Tsutomu Tsuboi (Project leader)

Almost one and half year has passed since Pandemic started March 2020. All projects in SATREPS have to be done under limited condition. In January we have 6th wave for COVID-19 infection spread and 3rd wave in India. From year 2020 to 2021, new coronavirus variant has come. However, we had on-line meeting among teams, thanks for ICT technology today. From this month October, the situation becomes better and better.

Let me introduce the local news of "Bangalore Mirror"(*). The new JICA ODA project for improvement local traffic was announced in August 8– recently awarded the contract to Nagoya Electric Works Co. Ltd. It announced that the Japanese technology promises to reduce the waiting time.

This news encouraged our SATREPS and makes sure our contiguous research importance.

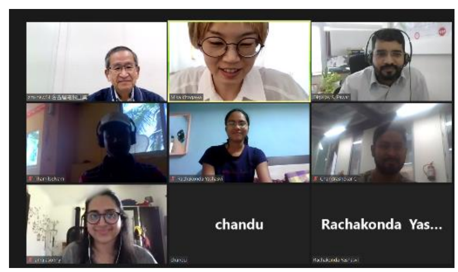
Work on the handbook has begun in earnest.

by Misa Kitagawa (Residential Coordinator)

Progress management of the handbook has launched, and a series of internal meetings were actively held in late September. Group 2 - 4 had the group meeting, in which the authors of the chapters were assigned and their contents were confirmed. The all-Japanese member also gathered for 27th SATREPS general meeting. Even though it was held online, there was a lot of lively discussion especially about what measures could be taken to ensure the smooth development of the handbook, which results in extension of the meeting beyond the scheduled 2hours.

Another topic was about the Co-symposium with Project in Thailand(→See Page.7). It would be effective to present a draft of the handbook at the symposium, so we will continue to try to facilitate this process.

(*)Read more at: https://bangaloremirror.indiatimes.com/bangalore/cover-story/made-in-japan/articleshow/85142932.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst



Group 3 meeting on 29th Sep

Recent scenes of IITH

भारतीय प्रौद्योगिकी संस्थान हैदराबाद
Indian Institute of Technology Hyderabad
Nagoya
NAGOYA ELECTRIC WORKS CO., LTD.
日本大学

GROUP REPORTS

Group 1: Multi-object tracking for traffic surveillance and control

by C. Krishna Mohan (Group 1 Leader), K Naveen Kumar, Vineel Abhinav G, Pabbathi Uday Kumar, Sai Harsha Yelleni, Jaya Sharma

Group1 is working on formulating methods using deep learning frameworks to estimate the position and state of multiple objects at every timestep in a traffic surveillance video. Tracking more than one object in the video raises several challenges, including correct mapping of identity to each object throughout the video, frequent occlusions, initialization and termination of tracks, and similar appearance of different objects.

To address these difficulties/challenges, we have used:

1. Siamese neural networks to correctly map identities to correct objects.
2. Memory module to store the state of the object for a long time. It helps in re-initiating the state of an object that has been lost due to occlusion.
3. Segmentation mask module for an accurate representation of objects. It classifies whether each pixel belongs to an object or not.

Robust tracking of objects also helps in improving the performance of tasks such as vehicle counting and speed estimation which require multiple objects to be tracked.

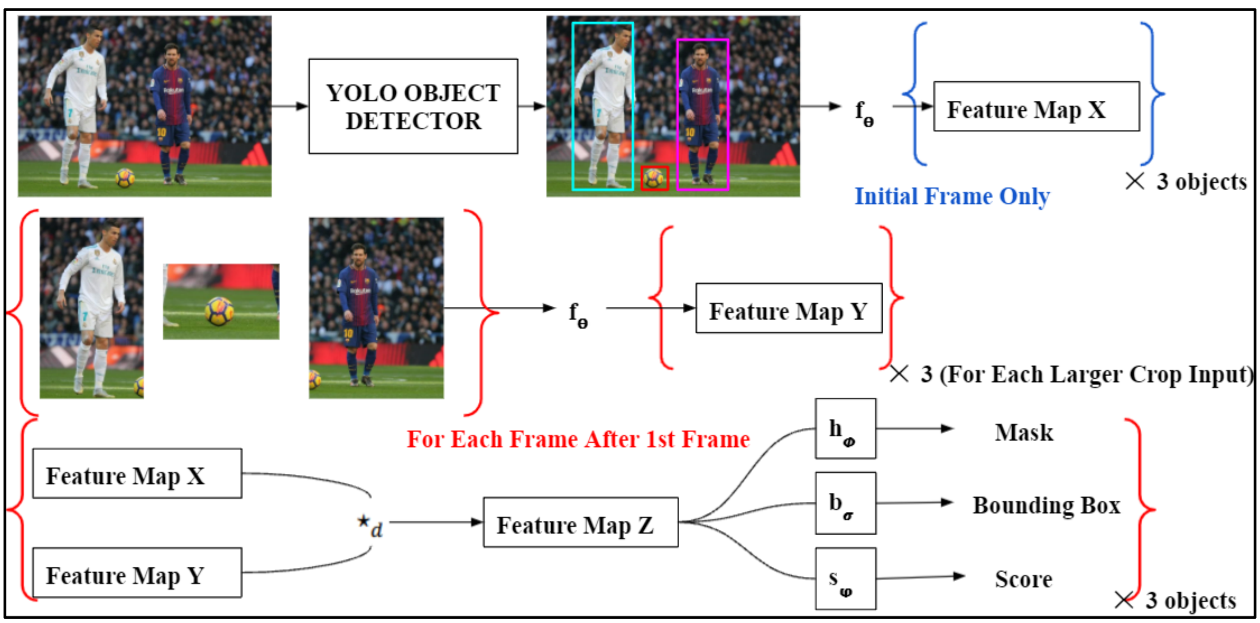


Figure 1: Proposed architecture for multi-object tracking

Methodology of Proposed Approach

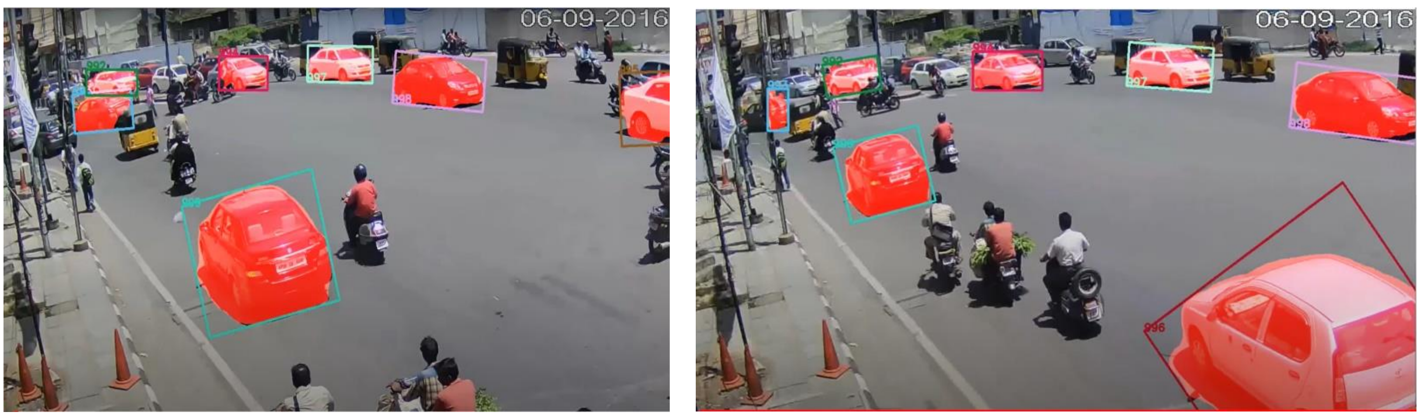
Figure 1 represents the architecture used to track multiple objects

1. We use YOLO object detection for the initial frame only to output bounding boxes of objects of interest. We call them exemplar images.
2. We use a siamese neural network f_θ (ResNet-50 base) to extract features for each object (Feature Map *X*).
3. For each frame *i* after the first frame:
   a. For each object *j*, we take the region in frame *i*, which corresponds to the location of the larger crop of the bounding box of *j* in frame *i-1*. We call them the search regions.

b. We then send these search regions into f_θ to obtain features for each object's search region (Feature Map Y).
c. We use depthwise cross-correlation ($*d$) between feature maps of respective objects to obtain an activation map representing the location of an object in frame i (Feature Map Z).
d. We use fully convolutional nets (h_ϕ) to obtain a mask for each object for accurate pixel-wise tracking.
e. b_σ outputs a bounding box corresponding to the highest score s_ψ.

Outcome

Given a video stream from a surveillance camera, our model would process each frame in the video to provide positions and state information of multiple objects. Figure 2 represents two sequential frames of video where 7 cars (object of interest) are tracked along with segmentation



(a) (b)

Figure 2: Tracking output 7 cars. (a) & (b) are two frames in video

References:

[1] Wang, Qiang, Li Zhang, Luca Bertinetto, Weiming Hu, and Philip HS Torr. "Fast online object tracking and segmentation: A unifying approach." *In Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)*, pp. 1328-1338.2019.

[2] Li, Bo, Junjie Yan, Wei Wu, Zheng Zhu, and Xiaolin Hu. "High performance visual tracking with siamese region proposal network." *In Proceedings of the IEEE conference on computer vision and pattern recognition (CVPR)*, pp. 8971-8980. 2018.

GROUP REPORTS

Group 2 – The Prediction of Road Traffic States

by Tetsuhiro ISHIZAKA, Maunendra Sankar Desarkar

The Goal of group 2 is to generate insights to help in better city and travel planning to avoid congestion and thereby reducing overall CO_2 emission based on predicted traffic states and performance of road and public transportation obtained from various sources.

In this newsletter, the research outcomes regarding on the prediction of road traffic states is shown. We have two approaches to estimate traffic states at Paldi intersection : "Traffic Volume Prediction" and "MFD Prediction".

Traffic Volume Prediction using Observed Traffic Volume

Our project installed four traffic detectors and one CCTV camera at Paldi intersection. There was no traffic sensor along 6 km between APMC and Ashram road before installation. Even if Ahamedabad with promoting of traffic sensor, there are still sparse area with no observation of traffic state. In order to reveal traffic state, the LSTM model is applied for estimation of traffic states at the target intersection using observed traffic volume as following condition. As showing the Fig 2 and 3, The prediction model can perform with high accuracy.

Dataset: Total 139 days from 2018-11-19 to 2019-08-29
Train set :80% and Test set :20%
Time Interval:15 min
Method: LSTM
Result: R^2=0.957

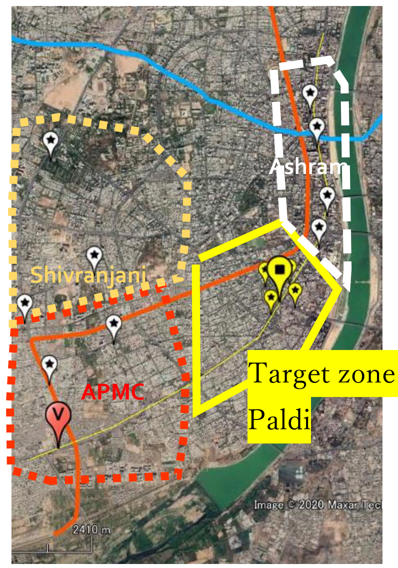


Figure 1: Study area and traffic detectors

MFD Prediction using Observed Traffic Volume

MFD is one of key performance indicator to express area traffic states. MFD expresses the interaction between area traffic states which connecting the total number of cars on the road at any given time (the accumulation) with the rate at which trips reach their destinations (the output). The area is set as group of detectors in Figure 1. Paldi area (Yellow boundary) is a targeted area of estimation form other three area. Both MFD indicators were estimated with high accuracy in comparison with observed data form traffic detectors in Figure 4.

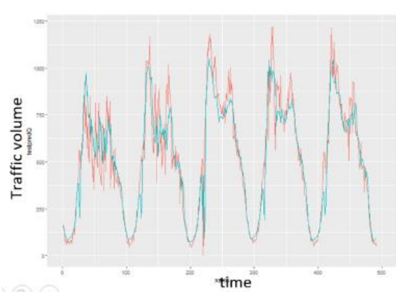


Figure 2: Estimated traffic volume

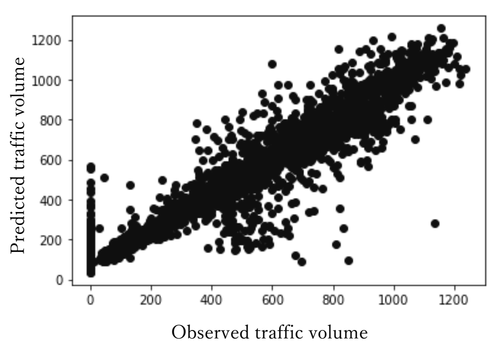


Figure 3: Estimated & observed traffic volume

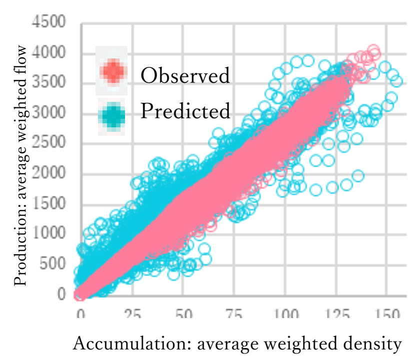


Figure 4: Estimated MFD indicators

GROUP REPORTS

Group 3 A – Vehicular exhaust emission under real-world driving conditions :Role of electric-vehicles on reducing pollutant emission

by Dr. Digvijay S. Pawar (Group 3 Leader), Chandrashker. C

The road transportation sector contributes to greenhouse gas (GHG) emissions, accounting for approximately 20 percent of carbon dioxide (CO2). The increase in vehicular growth and limited use of emission control strategies leads to a significant contribution to road transport emission. Several studies developed an emission factor based on a laboratory test. However, laboratory-based emission measurements do not replicate real-world driving conditions. Therefore, it is crucial to accurately measure emissions from combustion engines under real-world conditions to provide realistic figures for an emission inventory.

In view of the above, Group 3 has been working on the direct measurement of emissions from diesel auto-rickshaws for India's urban and rural traffic conditions, setting a test route of 14km stretch in Sangareddy city. In the previous Newsletter Vol.12, we have pointed out the possibility that emission factors obtained from a laboratory test may underestimate the real world emmissions based on the observation of our studies about relationship between emission factors and average speeds.In this article, we will focus on the interpretation and insights for policymakers.

The summary of the results

A speed-based emission model was developed for both urban and rural traffic conditions. The emissions were found to be high at both low and high speeds and minimum at moderate speeds. On-road emission for urban traffic conditions was found to be slightly higher compared to rural traffic. From the res ult, **the emission factors from urban traffic were found to be substantial than rural traffic**. The resu lt showed that the lowest driving speed contributed to a significant portion of total CO2 and CO emissions over a trip, as shown in Figure 1 (a-d).

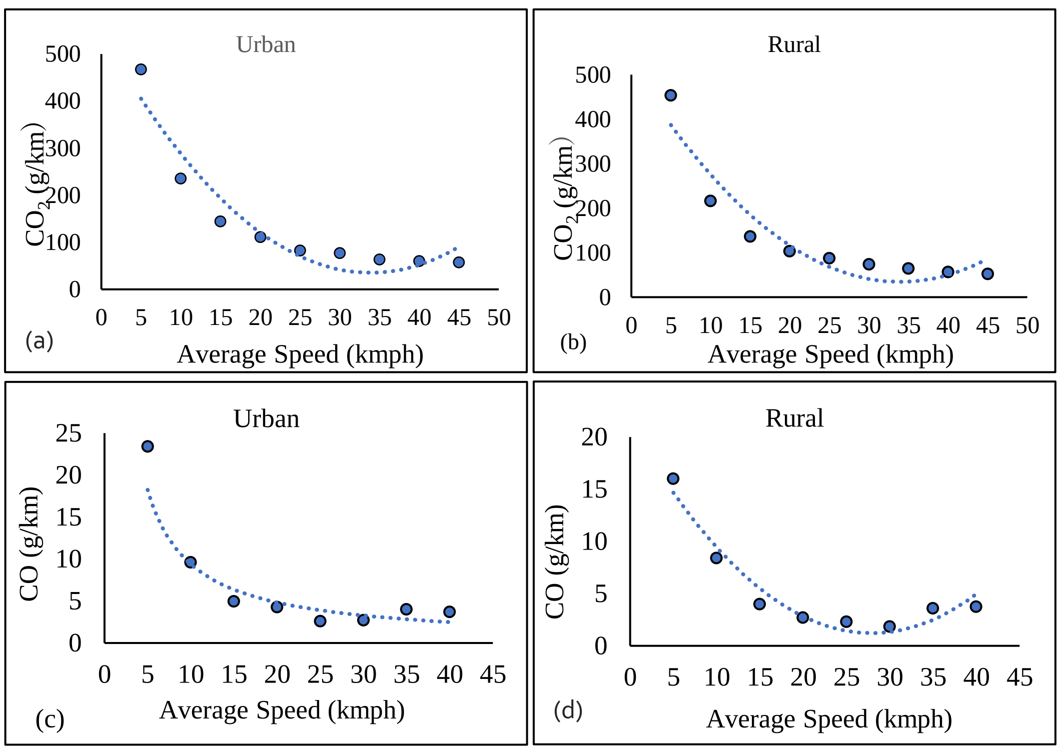


Figure 1. Emission factor for different average speeds

Real-world emission and policy implementation

The insight from the study can be used to understand the emission factors from diesel auto-rickshaws which will be helpful for policy formulation and traffic management system for better air quality.

The emission standards prescribed by the Automotive Research Association of India (ARAI) are based on laboratory testing of the vehicles, and there has been limited prominence on real-world emissions monitoring. Thus, it is crucial to verify emission control system performance and durability, not just in laboratory certification tests of new engines but also in the real-world driving conditions, which will be needful for emissions standard formulations. Finally, **a combination of the policy decision, including congesting pricing, encouraging public transport services, and carpooling, would be necessary to reduce emissions drastically**. **Introducing e-rickshaw in urban traffic** with proper charging infrastructure could be a possible replacement for fossil fuel-based auto rickshaws to improve the city's air quality.

GROUP REPORTS

Group 3 B– Evaluation of major road driver response towards intersection conflict warning system at an uncontrolled intersection

by Dr. Digvijay S. Pawar (Group 3 Leader), Chandrashker. C

Rural intersections are the critical at locations where most of the accidents take place. Crashes at these intersections mainly occur due to poor sight distance, wrong judgment in gap acceptance by minor road vehicles, and major road vehicles speed. An intelligent transportation system application known as Intersection Conflict Warning System (ICWS) has been commonly used in developed countries like United States to reduce crash severity and enhance safety at intersections.

This study evaluates the performance of ICWS at an uncontrolled intersection by examining the drivers speed profiles for three scenarios. A vehicle instrumented with GPS (Global Positioning System) device and video camera system was used for data collection at uncontrolled intersection and at the end of the experiment, participants were asked to fill a post sign questionnaire to assess the degree to which warning sign assisted them to cross the intersection and also to assess participants' perception of usefulness and acceptance of warning sign.

Figure 1 depicts the average speed profiles of all the drivers for three scenarios. The vertical line in the figure represents the intersection where a minor road vehicle enters.

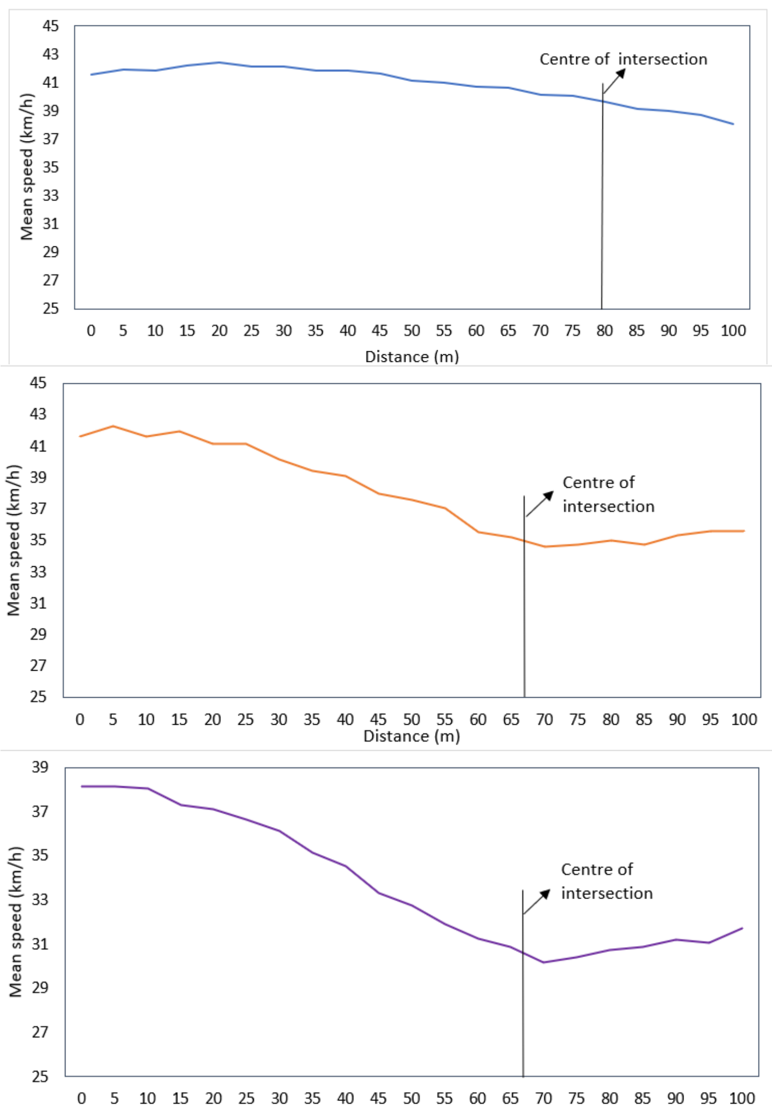


Figure 1. Average speed profiles of drivers for different scenarios (a) Scenario 1 (b) Scenario 2 (c) Scenario

Figure 1(a) represents the average speed profile of all drivers for scenario 1, i.e., a conflicting vehicle was not present on the minor road. The average speed of all drivers was found to be 41.44 km/h.

Figure 1(b) represents drivers' average speed profiles for scenario 2, i.e., a conflicting vehicle was present on the minor road. The average speed of all drivers was found to be 39.63 km/h.

Figure 1(c) represents drivers' average speed profile for scenario 3 i.e., drivers were educated about the deployed warning system, and the conflicting vehicle was present on the minor road. The average speed of all drivers was found to be 34.92 km/h.

From the figure we can observe that in scenario 3 drivers tend to reduce more speed compared to scenario 2 and scenario 1 when they approach the intersection. **This indicates that the drivers with a better understanding of the warning system could respond before they approach the intersection and can avoid sudden braking at the intersection.** A post signage questionnaire form results show a positive response from drivers saying that the warning system would be helpful in reducing collisions at uncontrolled intersections.

Further we plan to evaluate the performance of ICWS for both major and minor road drivers approaching the intersection.

GROUP REPORTS

Group 4 – Analysis of accessibility to facilities in Ahmedabad

by Atsushi Fukuda (Group 4 Leader), Hiroki Kikuchi

Improving the transportation system has a great impact on various activities in the city. One of the ultimate goals of Group 4 is to estimate the effect of introducing the multi-modal transportation system proposed in Ahmedabad, especially the effect of reducing CO_2 emissions. In this time, we will introduce the results of estimating accessibility based on Point of interest (POI) in the entire city, which is one index for evaluating the transportation system, for Ahmedabad. This is a prerequisite for estimating the reduction of CO_2 emissions by introducing a multi-modal transportation system.

POI is geo-coded facilities such as office towers, residential estates, theaters, schools, restaurants, supermarkets, and hospitals that residents and visitors patronize on the daily basis and that are indispensable for cities and towns to function properly. Compared to traditional datasets such as local land use maps, POI data are markedly advantageous in capturing urban development.

Therefore, our group analyzed the accessibility of POIs from each mesh using a geographic information system (GIS) in order to clarify the reachable facilities by multimodal transport. Figure 2 describes the number of reachable facilities (hospitals) in one hour for each mesh.

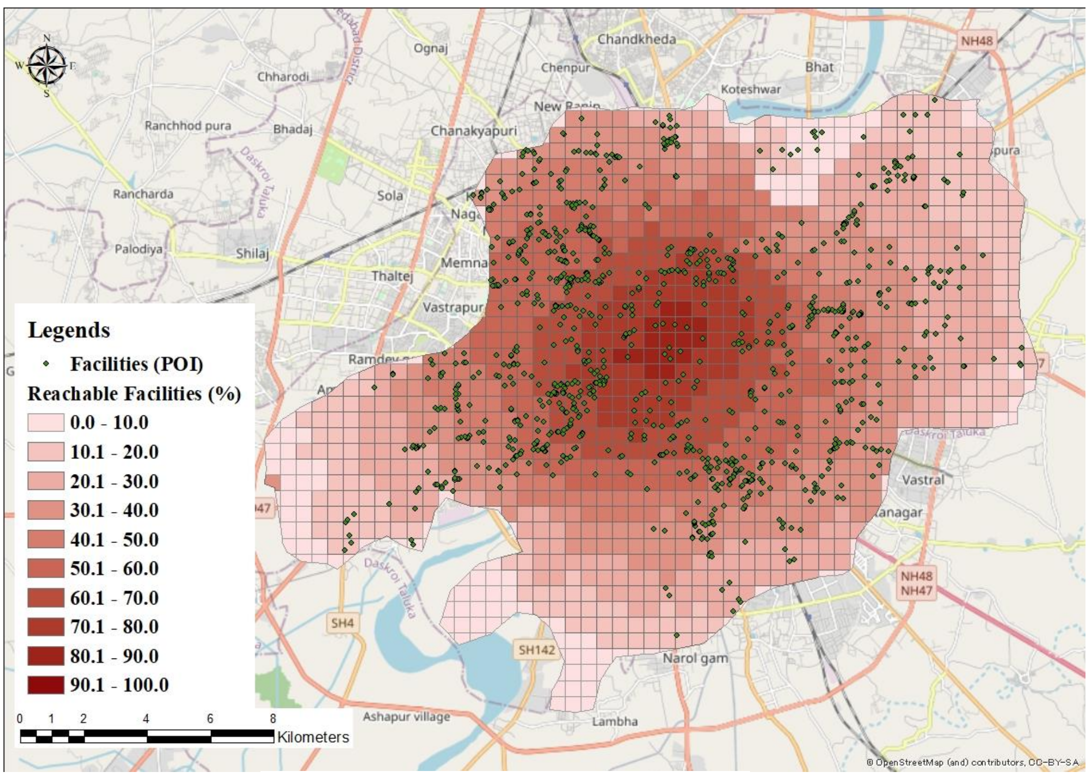


Figure 1: Analysis result of reachable facilities

The finding shows that accessibility is the highest in the urban areas, and it is possible to access about 100% of the facilities within the coverage area within one hour. Even within a radius of 8 km from the city center of urban areas, the accessibility is lower than 10%. This means that there is a significant disparity in accessibility even within the urban areas.

We will estimate the changes in accessibility and analyze these disparities when the entire portion of the metro in the Ahmedabad line opens. Also, we will analyze the impact of long-term policy implementation using the land-use and transportation model and will report those results in our following newsletter.

OTHERS

Co-Symposium with "Smart Transport Strategy for Realizing Thailand 4.0" is planned in early 2022

by Atsushi Fukuda (Group 4 Leader)

The group headed by Prof. Yoshitsugu Hayashi of Chubu University, Japan and Prof. Thanaruk Thiramunkon, Thammasat University, Thailand is conducting "Smart Transport Strategy for Thailand 4.0" which is another smart transport related SATREPS project, that mainly focuses on Bangkok, Thailand.

Main objectives of this project are : 1) to achieve leapfrog growth based on the "Smart Transport Strategy" and 2) to contribute to "Thailand 4.0" and SDGs through the "Sukhumvit Model". As you can see from this, this project and our M2SMART project have much in common, hence, JST has advised us to hold a joint symposium.

So both projets are planning to hold the joint seminar to exchange information, insights, views among each other, with the aim of networking and creating synergies between researchers.

The tentative plan of the programme at the moment will be as following:

1. An introduction to both projects
2. Evaluation and social implementation
3. Data collection and analysis
4. Challenges and future perspectives for both projects.

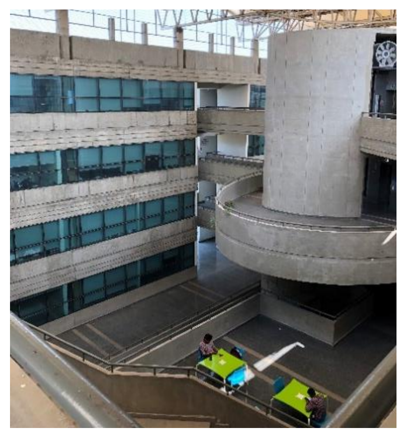
Although it will be held online, we hope that this joint symposium will be fruitful for both parties.

IITH is gradually normalizing

by Misa Kitagawa (Residential Coordinator)

After long standbytime, I've started to commute to IITH daily this week.

The situation seems to be better compared to my last visit in the end of the August, as some Phd students are coming back, however lectures for undergraduates students is being held online only and some faculty members are still working from home. The cafeteria remains closed and I imagined that students would be smiling again there.



My Timing & Location is below,.
Please feel free to have a casual talk!

- 9:00-12:00am
- Monday to Friday
- C-113/A

OTHERS

Publications

Journals

- Chandrashekar, C., Agrawal, P., Chatterjee, P., and Pawar, D. S. (2021). Development of E-rickshaw Driving Cycle (ERDC) Based on Micro-trip Segments Using Random Selection and K-means Clustering Techniques. IATSS Research. (In press) (DOI:https://doi.org/10.1016/j.iatssr.2021.07.001).
- Chandrashekar, C., Chatterjee, P., and Pawar, D. S. (2022). Development of real-world CO_2 and CO emission factors from diesel-auto rickshaws in Indian Urban and Rural Driving Conditions. Proceedings (CD-ROM) of 101th Transportation Research Board Annual Meeting, Washington D. C.
- Rachakonda, Y., and Pawar, D. S. (2022). A Review on Evaluation of Intersection Conflict Warning System at Rural Intersections. Proceedings (CD-ROM) of 101th Transportation Research Board Annual Meeting, Washington D. C.

Conference presentations

- **Vehicular Technology Conference (VTC)** Fall 2021 by IEEE Vehicular Technology (Virtual presentation date : 30th Sep 2021), by Dr. Antony Franklin, "Traffic-Aware Sensing-Based Semi-Persistent Scheduling for High Efficacy of C-V2X Networks"
  "This paper explicates the impact of pKeep(probability of keeping a radio resource) and RC(Resource Counter) on the overall performance of C-V2X system. And a new algorithm called Traffic-Aware SPS (TA-SPS) is then proposed, which optimally configures these parameters according to the current density of road traffic by estimating it from periodic messages broadcasted by the vehicles. By reducing the number of resource collisions, TA-SPS increases transmission reliability of the C-V2X system and outperforms the traditional SPS(Semi-Persistent Scheduling) in mixed road traffic scenarios."

Upcoming Conference

- The 24th Brazilian Symposium on Formal Methods (SBMF 2021)(Virtual event), 6-10th December.
- The Transportation Research Board (TRB) 101st Annual Meeting, 9-13th January.

M2Smart

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