Data Analytics for Research and Education (DARE)

Proj 2: Design and analysis of algorithms

May T. Lim
National Institute of Physics, UP Diliman

TSSP ITS Forum
25 October 2019

Funding agency:

Governance

Proj 3: Stakeholders' concerns and performance indicators

Engineering
MAPÚA UNIVERSITY

Proj 1: Data hub (receive, organize, transmit)

Proj 2: Analyze, model and predict

DARE leverages strengths and linkages of implementing units

Computational physics

Approach

- Use data to build models
- Study interplay of behavior and system using microscopic traffic models
- Perform scalable modeling using mesoscopic traffic models
- Create tools when data is not available

Computing platform

Reconfigurable cluster for academic research

Located at NIP, UP Diliman
cloud@nip - 24/7/365 operation

DARE P2 Research Team @ NIP, UP Diliman

Project staff (5):
M. Lim (PL)
D. Dailisan
A.C. Balingit
L.J. Rubio
I. Fenis

Complemented by undergraduate researchers

http://cxteam.liknayan.com
The Complex Systems Team (CXTeam) is one of the research groups of the Instrumentation Physics Laboratory of the National Institute of Physics

Approach

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PLOS ONE

RESEARCH ARTICLE

Modeling the residential distribution of enrolled students to assess boundary-induced disparities in public school access

Louie John M. Rubio[1], Damian N. Dailisan[1], Maria Jeriesa P. Osorio[2], Clarissa C. David[2], May T. Lim[1]*

1 National Institute of Physics, University of the Philippines Diliman, Quezon City, Philippines, **2** College of Mass Communication, University of the Philippines Diliman, Quezon City, Philippines

Evaluate access using school location and enrolment

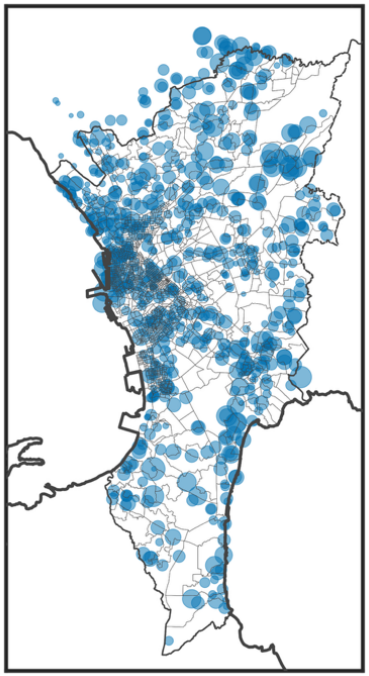
OPEN ACCESS

Citation: Rubio LJM, Dailisan DN, Osorio MJP, David CC, Lim MT (2019) Modeling the residential distribution of enrolled students to assess boundary-induced disparities in public school access. PLoS ONE 14(10): e0222766. https://doi.org/10.1371/journal.pone.0222766

Abstract

Given school enrollments but in the absence of a student residence census, we present a gravity-like model to infer the residential distribution of enrolled students across various administrative units. Multi-scale analysis of the effects of aggregation across different administrative levels allows for the identification of administrative units with sub-optimally located schools and highlights the challenges in allocating resources. Using this method, we verify that the current scheme of free cross-enrollment across administrative boundaries is needed in achieving universal education in the Philippines.

Perform origin-destination inference



school locations
(size proportional to
2013 population)

School enrollment and barangay population data

↓

OD matrix generation

$$T_{sb} = (\textbf{school population})_s \times \frac{(\textbf{barangay population}) \cdot \min\left\{1, \left(\frac{R_c}{r_{sb}}\right)^{\alpha}\right\}}{\sum_b (\textbf{barangay population}) \cdot \min\left\{1, \left(\frac{R_c}{r_{sb}}\right)^{\alpha}\right\}}$$

The O-D inference scheme **can** be extended to establishments with available occupancy data.

Dailisan, D. N., Rubio, L. J., Osorio, M. J., David, C., & Lim, M. (2018). Degree distributions of Origin-Destination matrices generated from school and barangay population data. *Proceedings of the Samahang Pisika ng Pilipinas*

Rubio, L. J. M., Dailisan, D. N., Osorio, M. J. P., David, C. C., & Lim, M. T. (2019). Modeling the residential distribution of enrolled students to assess boundary-induced disparities in public school access. *PLoS ONE*

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previous work

Physica A 457 (2016) 138–147

Contents lists available at ScienceDirect

Physica A

journal homepage: www.elsevier.com/locate/physa

Agent-based modeling of lane discipline in heterogeneous traffic

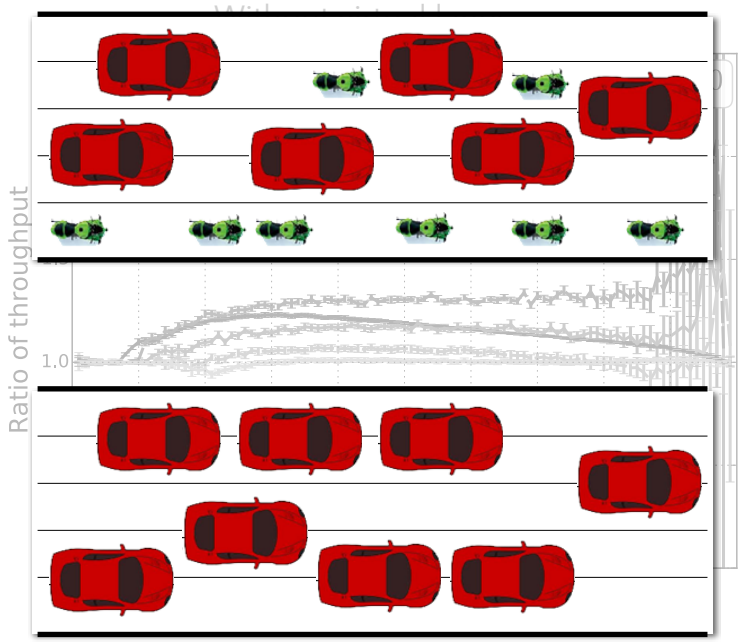
Damian N. Dailisan, May T. Lim *

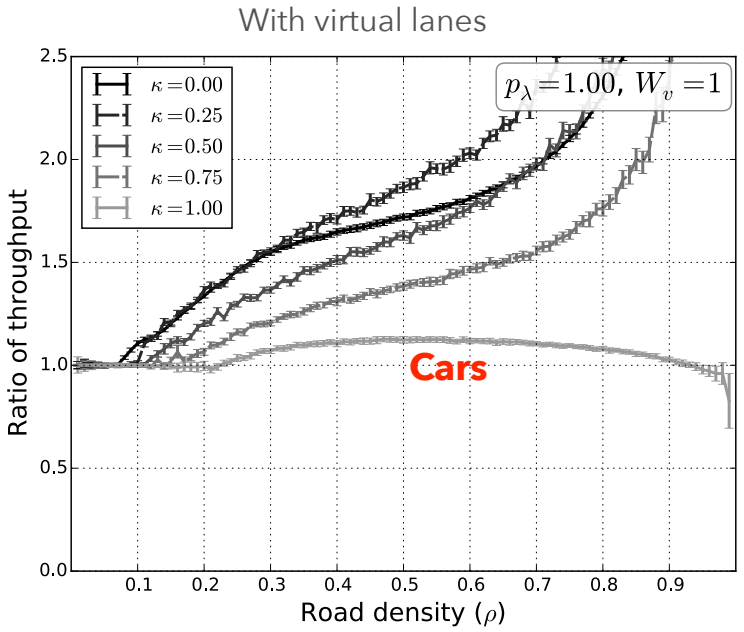
National Institute of Physics, University of the Philippines Diliman, 1101 Quezon City, Philippines

HIGHLIGHTS

- A modified Nagel–Schreckenberg model for heterogeneous traffic is proposed.
- Phase transition, from free flow to congested flow, depends on vehicle length.
- Lane change can benefit narrow vehicles, and is undesirable for wide vehicles.
- Lane discipline breakdown may improve throughput at the cost of safety.
- A simple collision index is proposed.

Why are there so many motorcycles?
Why do some drivers repeatedly change lanes?





Virtual lanes can **alleviate traffic jams.**

D. N. Dailisan and M. T. Lim. Agent-based modeling of lane discipline in heterogeneous traffic. Physica A (2016) DOI: 10.1016/j.physa.2016.03.104

Physica A 521 (2019) 715–723

Contents lists available at ScienceDirect

Physica A

journal homepage: www.elsevier.com/locate/physa

Vehicular traffic modeling with greedy lane-changing and inordinate waiting

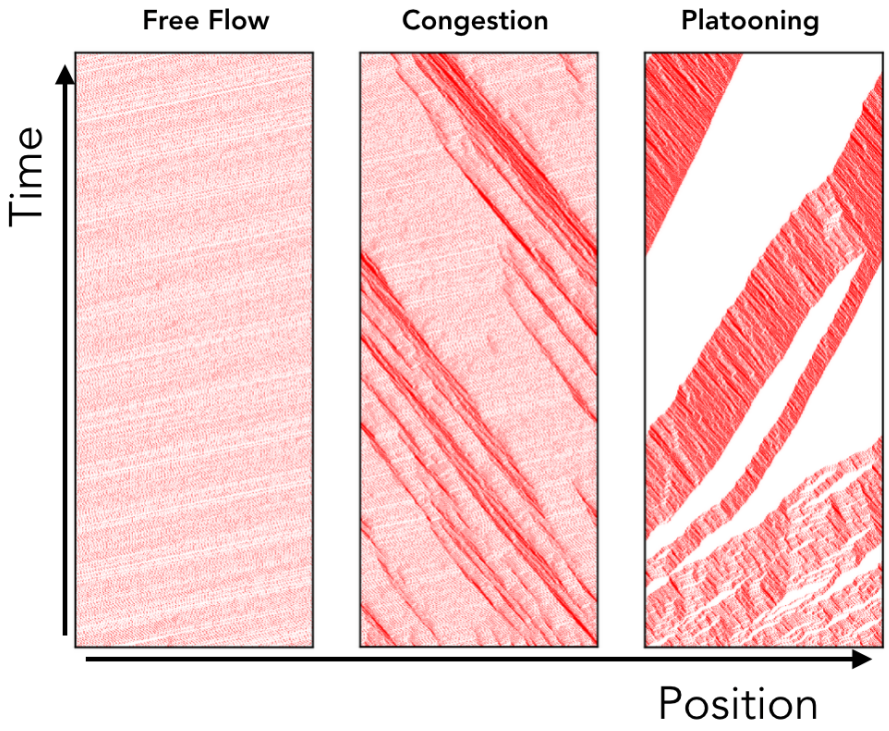
Damian N. Dailisan, May T. Lim *

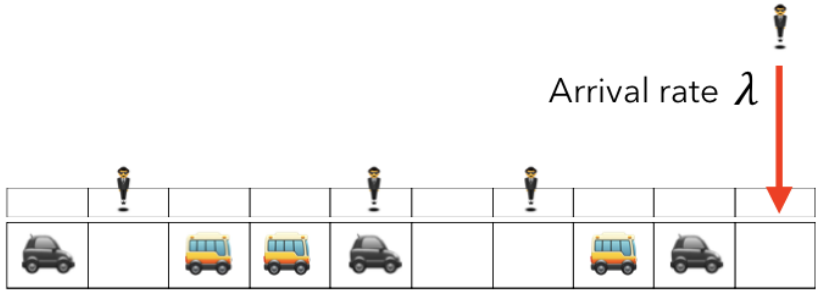
National Institute of Physics, University of the Philippines Diliman, 1101 Quezon City, Philippines

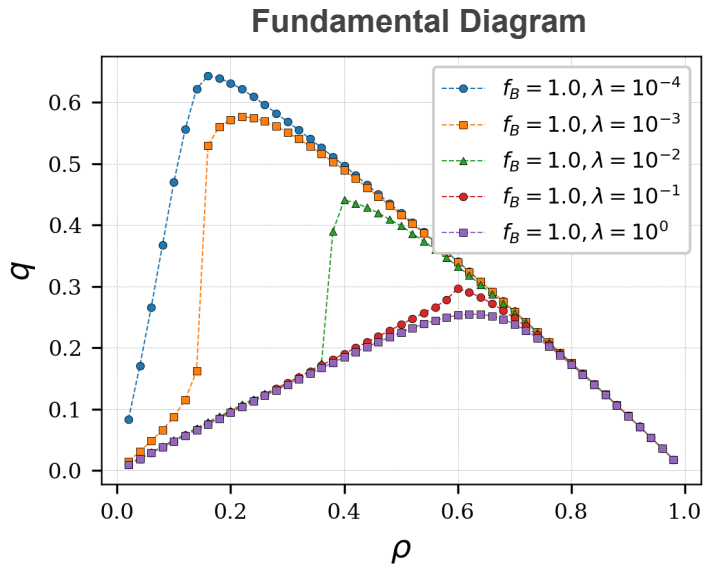
HIGHLIGHTS

- A modified NaSch traffic model is proposed with the addition of lane changing.
- The fraction of vehicles that change lanes move faster than those that do not.
- Increasing the fraction of lane changers has diminishing returns in the speed difference of vehicles.
- Phase transitions due to the value of slowdown probability are coupled with density.
- Slowdown transition is different from the density phase transition.

Bus-Pedestrian traffic model



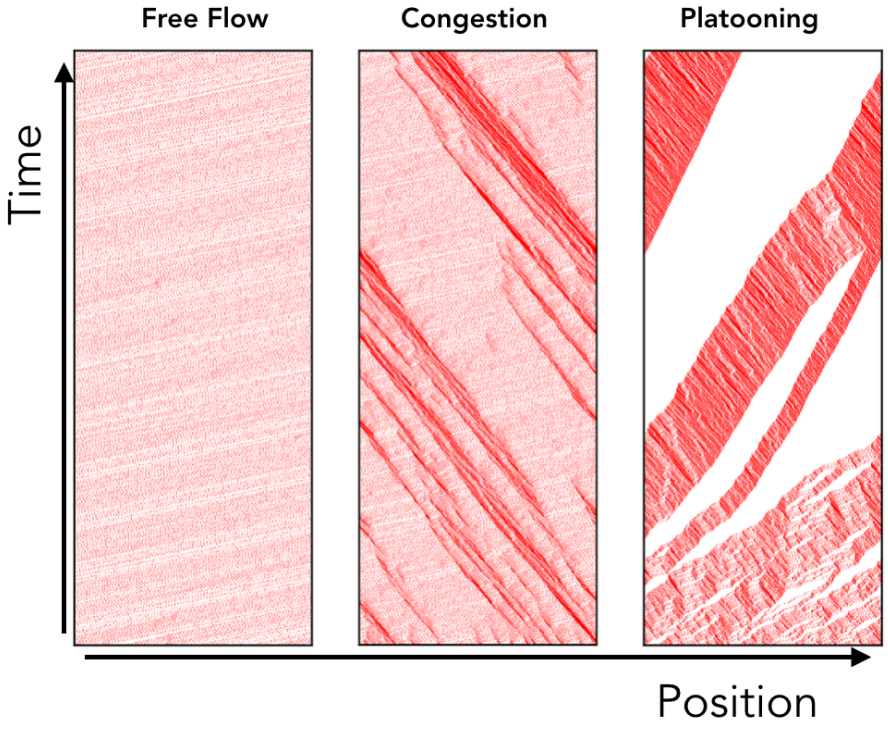


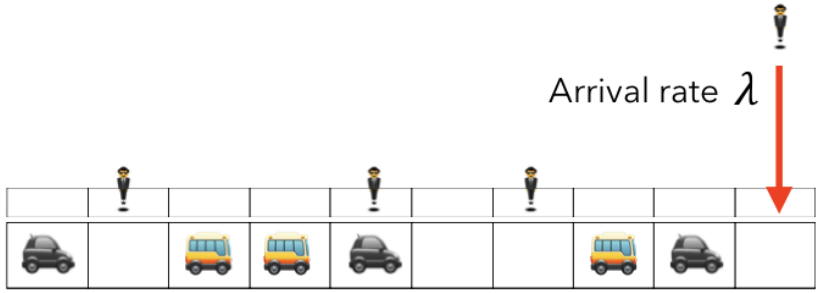


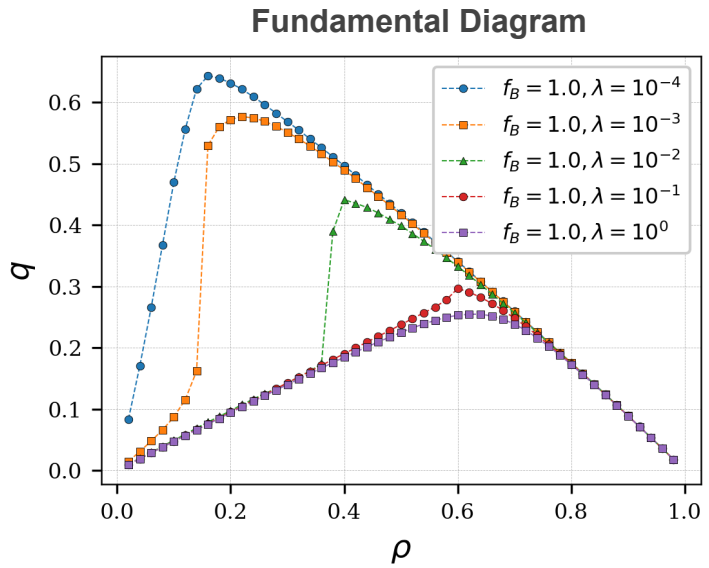
New fundamental diagram adapted to the Philippine context

Dailisan, D. N., & Lim, M. T. (2019). Jamming transitions in a mixed traffic cellular automata model. *Proceedings of the Samahang Pisika Ng Pilipinas*, (June), 2–5.

Bus-Pedestrian traffic model



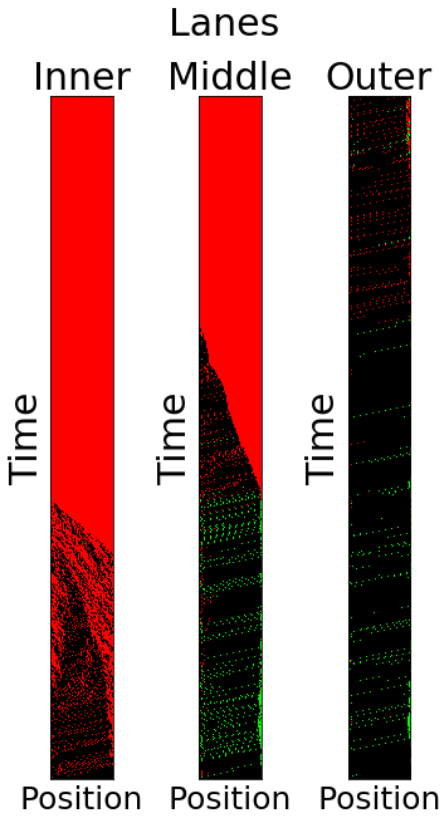


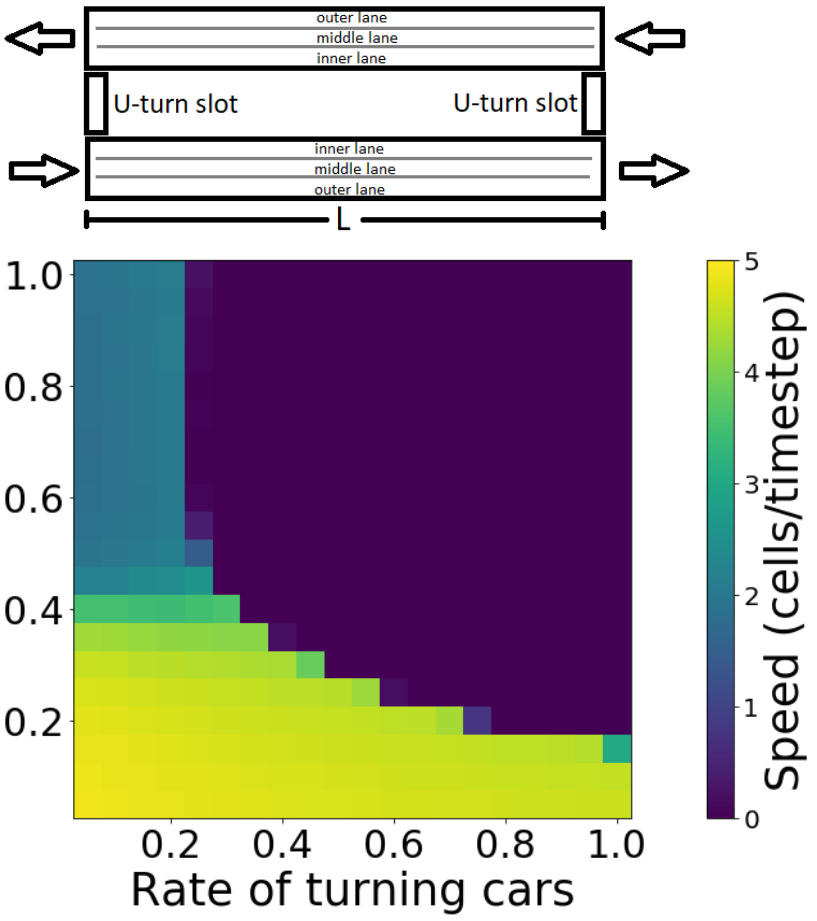


1. New fundamental diagram adapted to the Philippine context
2. **Crossover transition** points depend on arrival rates and density

Dailisan, D. N., & Lim, M. T. (2019). Jamming transitions in a mixed traffic cellular automata model. *Proceedings of the Samahang Pisika Ng Pilipinas*, (June), 2–5.

U-turn models





1. Dominant presence of **turning cars** over **non-turning cars** cause build-up and cascade of clogging to neighboring lanes
2. Clogging abruptly occurs at a U-turning cars threshold

Fenis, I. M., Dailisan, D. N., & Lim, M. T. (2019). Interplay of behavior and traffic dynamics in paired U-turn slots. *Proceedings of the Samahang Pisika Ng Pilipinas*.

Open Traffic Models (OTM)

- OTM is developed by Gabriel Gomes (UC Berkeley)
- OTM is a traffic simulation platform that implements models and control algorithms as Java plugins. Three basic models are provided: the cell-transmission model, the two-queue (mesoscopic) model, and Newell's car-following model.
- **otm-tools-python.** Python interface developed by Adrian Chester Balingit and Damian Dailisan (DARE Project 2) to expand the usage of OTM to Python programmers.

Create open source tools

Metro Manila network

- OSM [filtered: main roads]
  89,432 nodes
  240,023 edges
  25.25 km by 49.01 km

- Static routing algorithm exercise

Approach

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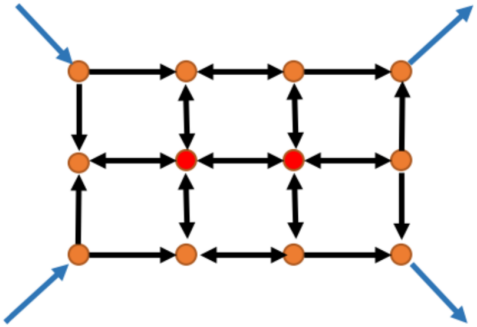
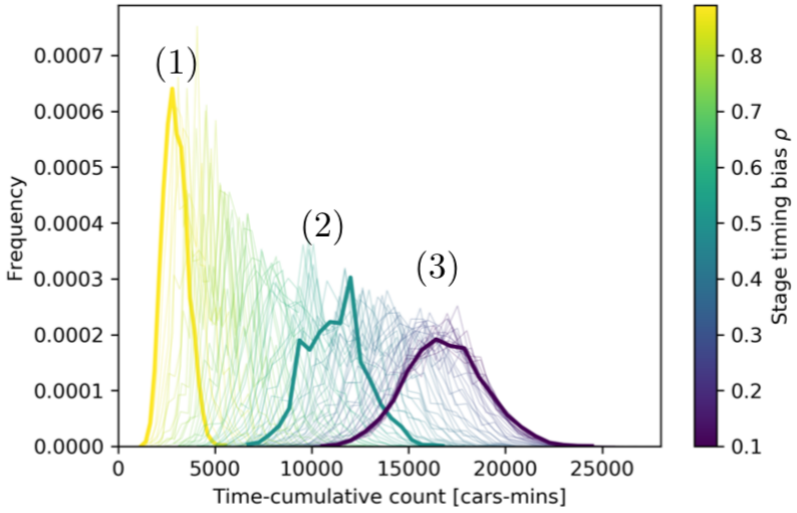
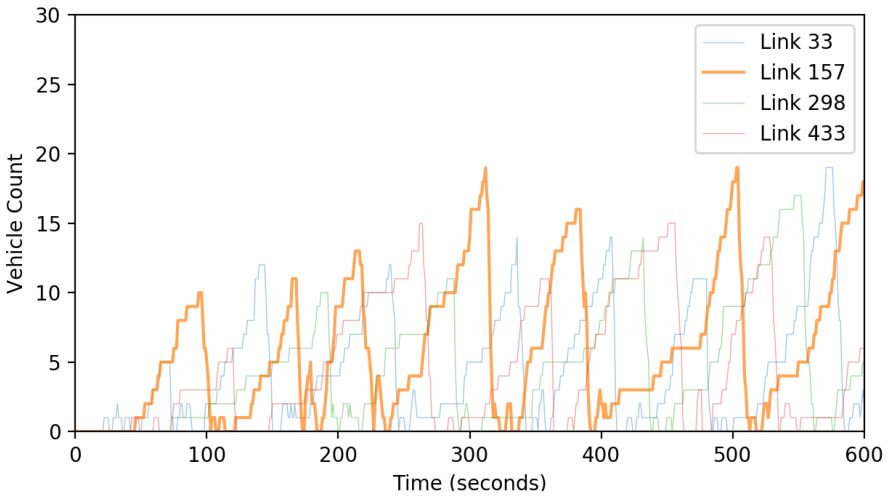
Traffic control

Study (first) using synthetic models





Eventually get to Manila conditions



Balingit ACM, Dailisan DN and Lim MT (2019). Mesoscopic simulation of road networks with time biasing of signalized intersections. *37th Congress, Samahang Pisika ng Pilipinas*. Tagbilaran City, Bohol

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data@sidewalks

Position, health, environment tracking

3:23	3:25	3:28	3:32	3:36
9/15/17, 3:23 PM	9/15/17, 3:25 PM	9/15/17, 3:28 PM	9/15/17, 3:32 PM	9/15/17, 3:36 PM
% rH 65.1	% rH 73.1	% rH 63.6	% rH 60.2	% rH 60.0
deg C 25	deg C 30	deg C 32	deg C 33	deg C 32
mbar 1001.3	mbar 1000.8	mbar 1001.6	mbar 1001.4	mbar 1000.5
Heat Index 25	Heat Index 35	Heat Index 38	Heat Index 40	Heat Index 37
-	Extreme Caution	Extreme Caution	Danger	Extreme Caution

Effort Watch	3:06
9/15/17, 3:06 PM	
Steps/sec	2
Sec/meter	0.7
Effort (live)	**89**
Effort (hour)	**25**
Past hr steps	1846
Distance, m	1369

Gauging the difficulty of moving around

Proof-of-concept work funded by DOST- NAST

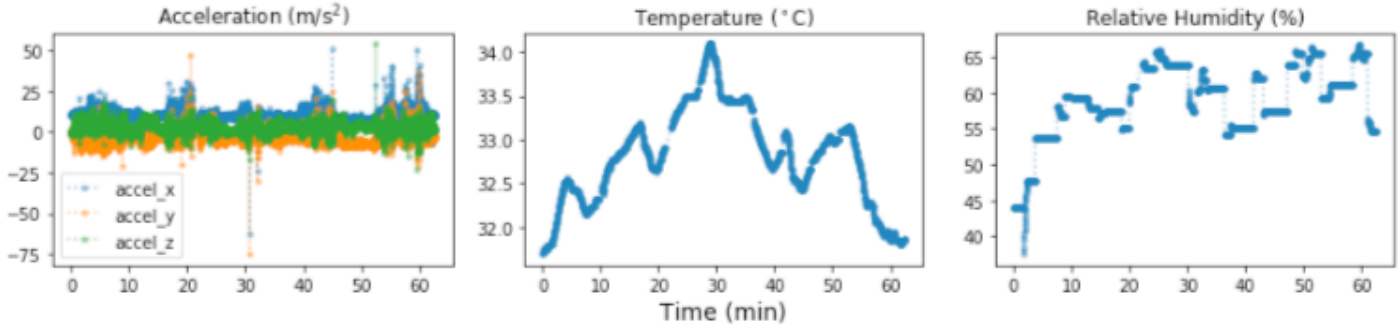

Figure 2: Raw data for acceleration, ambient temperature, and relative humidity obtained from a sample commute. Change of commute mode reflects in the sudden changes measured.

The “commuter experience”

L. Rizada, A.C. Balingit, M. Lim. Feasibility of a time-resolved index of commuter comfort. Proceedings of the Samahang Pisika ng Pilipinas 36th International Physics Conference. 6–9 June 2018 SPP-2018-3D-02-3

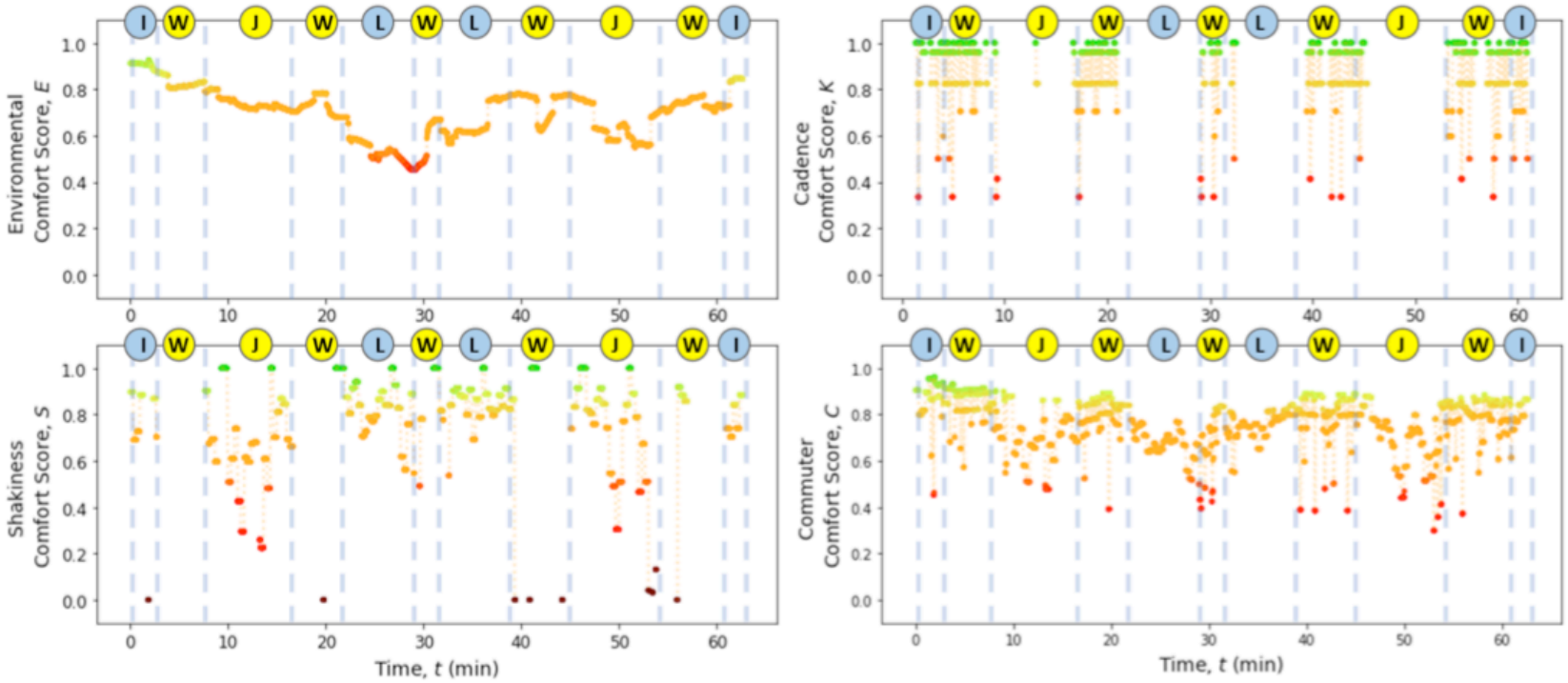

Figure 3: Comfort scores obtained from passing the measurements to the algorithm. The symbols above each plot label the type of activity within the commute: "I"-idle, "W"-walk, "J"-jeepney, and "L"-LRT 2. The blue circle and yellow circle correspond to an air conditioned setting and a non-air conditioned setting, respectively.

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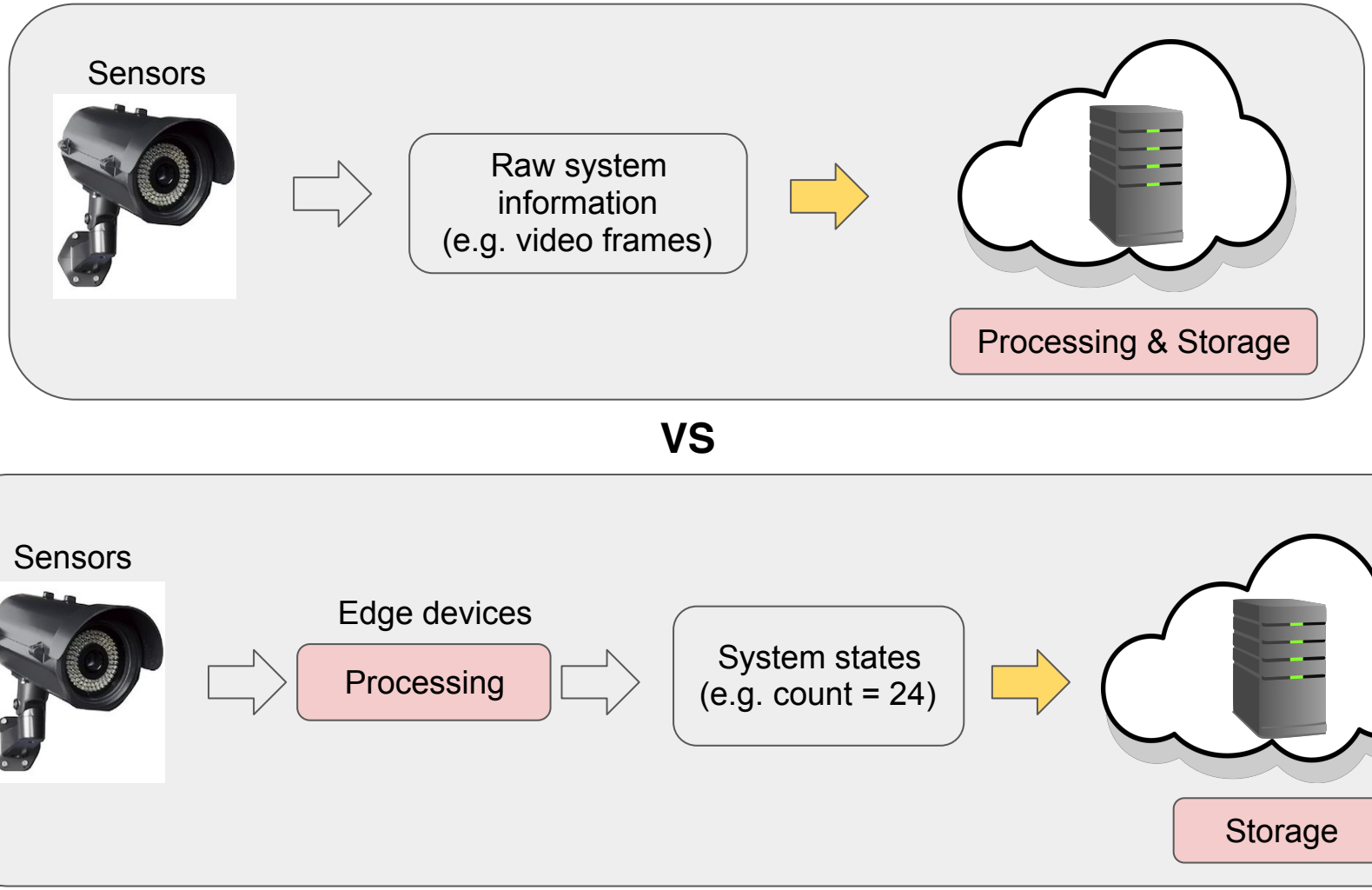
Moving forward: Edge inference (privacy-respecting algorithms)



Moving data processing algorithms to the edge addresses privacy concerns — detect, process, and send only **minimal info**

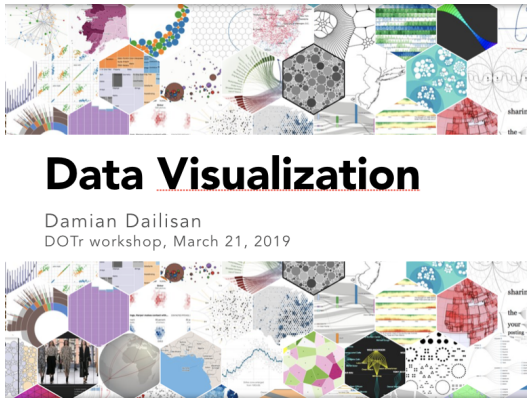
Education / Extension

Good data vs. bad data: Is this dataset useful?

A mini-workshop on transport data exploration & visualization using Python

Speakers & Facilitators:
M. Lim, A.C. Balingit, D. Dailisan, L.J. Rubio, I. Fenis
National Institute of Physics, UP Diliman

DoTr Workshop



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