Predicting the Impact of Disruptions to Urban Rail Transit Systems

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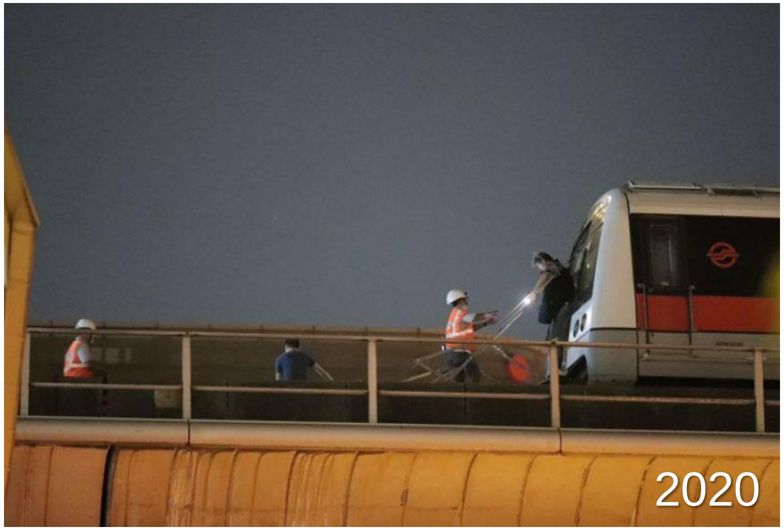
Metro disruption



The causes of disruption vary, from train fault, power failure, to extreme weather, etc.

Images from straitstimes.com

Metro disruption

- affected 413,000 commuters on 7 Jul, 2015
- affected 123,000 commuters on 14 Oct, 2020

Image from straitstimes.com

How many stranded commuters can be absorbed by nearby buses?

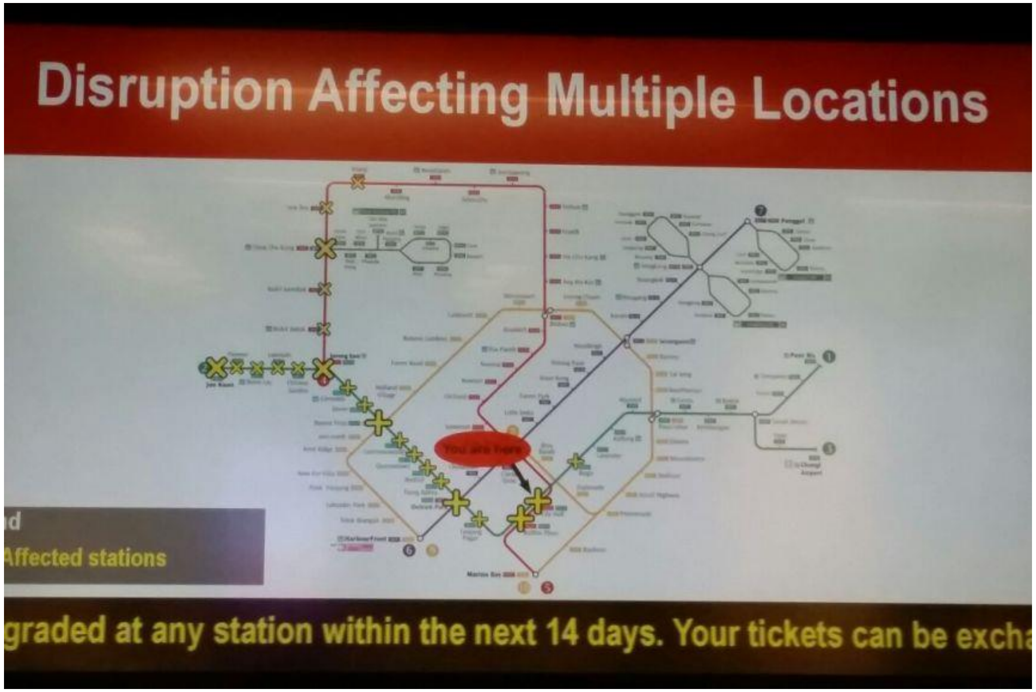
The resilience of the public transit system

The impact of disruption on commuters

Image from straitstimes.com

Predict impact

Given a disrupted metro network,



and a pair of affected Origin-Dest (OD) metro stations

Image from todayonline.com

Predict impact

We are to predict:

- What percentage of commuters will stay in the public transit system rather than leave for private transit?

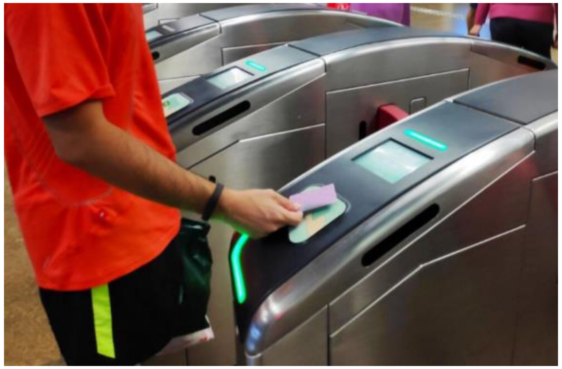
——the *stay ratio* metric

- How long is the average travel delay for commuters staying in the public transit system?

——the *travel delay* metric

Data

- Disruption time & locations: **official tweets**
- Commuters' trajectories in public transit system: **transit card records**

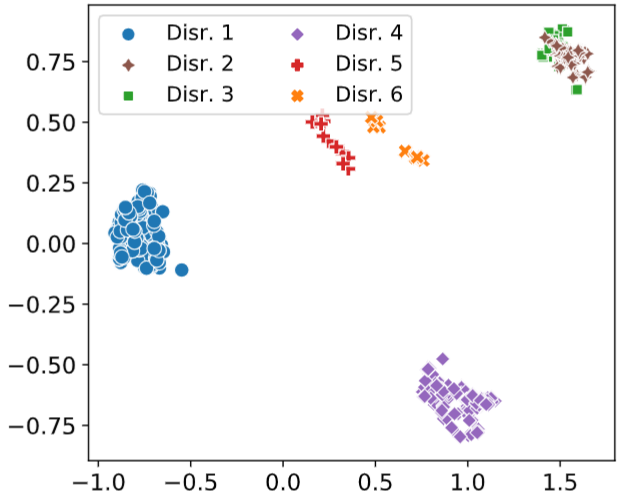


Key challenges

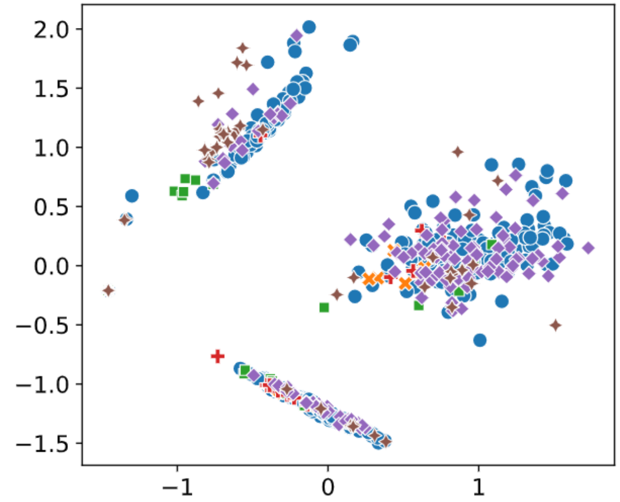
- Sample sparsity for supervised learning
  - 6 disruptions, hundreds of OD pairs
- Commuters' travel behaviours are too unstable to infer their decisions during disruption

Main ideas (1)

- Different disruptions hardly coincide in the domain of disruption and OD features.



- But they highly overlap in the domain of ***interested alternative route*** features.

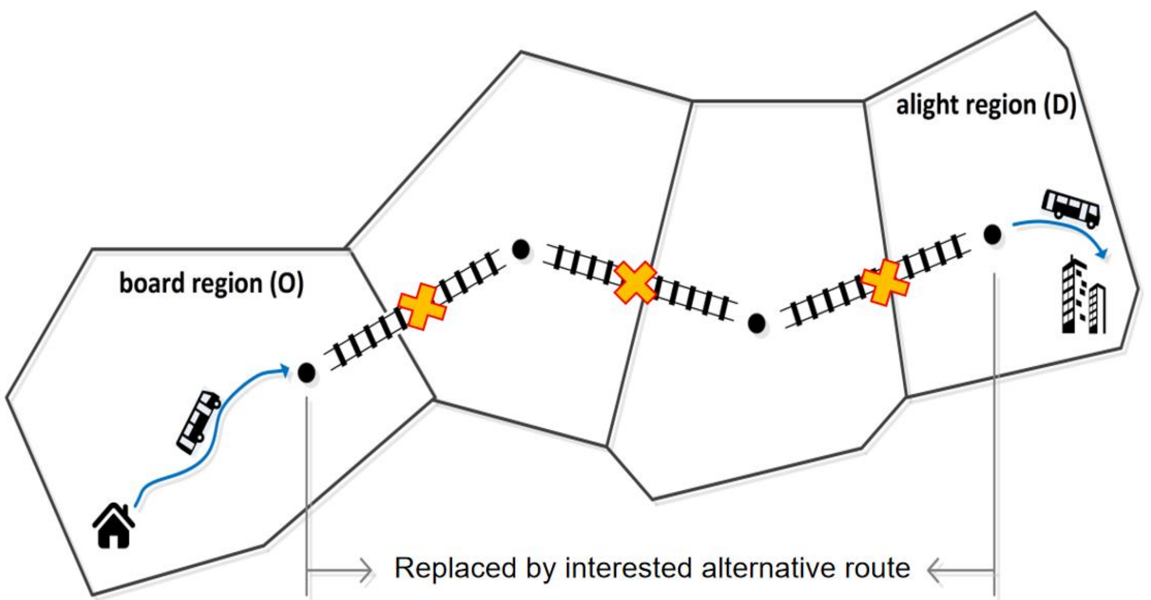


Main ideas (2)

- Recognize ***regular communters***
  - stabler departure time and OD
- on behalf of all commuters about their choices during disruptions

Main ideas (3)

- Generate interested alternative routes (IARs) based on the real choices of regular commuters
  - sample sparsity again about IARs for supervised learning
  - negative sampling
- Build predictors using IAR features for every impact metric



Evaluation

- We adopt a ***leave-one-out*** scheme to evaluate the impact predictors.
- We evaluate prediction accuracy and model stability of the proposed method.

Q & A