Epidemic Simulation on Small Community Using an Agent-Based Model Generated From OpenStreetMap Data

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Motivation and Objective

- The virus SARS-CoV2 (Covid-19), first detected in late 2019, started spreading worldwide in early 2020, causing a disease outbreak.
- An epidemic simulator is a key technology to understand how the disease spreads. Most epidemic models simulate a fictional city or do not use precise geolocation.
- This research proposes a simulator that uses geographic data to model a more realistic small community.

Model

We create a model that simulates how a virus spreads in small communities. The model consist of three main modules:

- **Environment Module:** This module is responsible for reading OpenStreetMap information and generating the environment where the agents will live or work.
- **Mobility Module:** This module defines how the agents move around the map. For example, agents can go to work, eat at a restaurant, go to a supermarket, etc.
- **Infection Module:** This module is responsible for simulating the spread of the disease. The probability of infection is defined in this module.

Fig. 1: Rendered view of our simulator

Experiments

We explore three different intervention scenarios and compare the results with a baseline experiment where no intervention was applied.

- Closure of public places such as restaurants and barbershops.
- Mass PCR testing intervention
- Closure of the restaurant and groceries and providing delivery instead.

Result

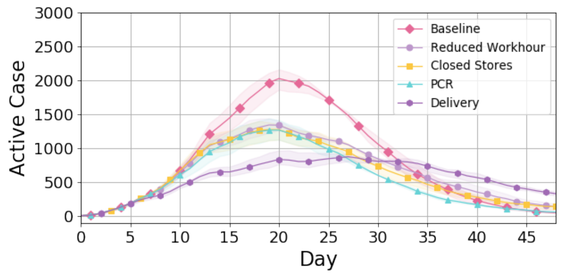

Fig. 2: Active cases per day

- Our simulator shows that most interventions reduce the number of active cases.
- The result for infection from the reduced workhour and total closure of the store is relatively similar. This result might indicate a harsher lockdown method might not produce better results.
- Mass PCR results shown to have similar results to reduced workhour and total closure.
- The delivery intervention seems to reduce the active case but seems to prolong the curve.

Result (contd.)

Fig. 3: Infection cases by location

- In the PCR case, the infection case at the hospital is rising. This increase is caused by the influx of people who go to the hospital to take the PCR test. Which accidentally creates infection clusters at the hospitals.
- Intervention targeting specific places (e.g., restaurants) seems to reduce infection at those places but does not affect others.

Conclusion

- We develop an agent-based epidemic model using OpenStreetMap data to explore scenarios and the factors that influence them. (e.g., Infection cluster at the hospital due to people keep taking PCR tests)
- While our results are not representative of what happened in the real world, the simulation can provide a sensible explanation of cause and effect for each intervention.