

Simulating the spread of COVID-19 with cellular automata: A new approach

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Abstract

Between the years 2020 to 2022, the world was hit by the pandemic of COVID-19 giving rise to an extremely grave situation. Many people suffered and died from this disease. Also the global economy was badly hurt due to the consequences of various intervention strategies (like social distancing, lockdown) which were applied by different countries to control this pandemic. There are multiple speculations that humanity will again face such pandemics in the future. Thus it is very important to learn and gain knowledge about the spread of such infectious diseases and the various factors which are responsible for it. In this study, we have extended our previous work (*Chowdhury et.al., 2022*) on the probabilistic cellular automata (CA) model to reproduce the spread of COVID-19 in several countries by modifying its earlier used neighbourhood criteria. This modification gives us the liberty to adopt the effect of different restrictions like lockdown and social distancing in our model. We have done some theoretical analysis for initial infection and simulations to gain insights into our model. We have also studied the data from eight countries for COVID-19 in a window of 876 days and compared it with our model. We have developed a proper framework to fit our model on the data for confirmed cases of COVID-19 and have also re-checked the goodness of the fit with the data of the deceased cases for this pandemic. Our model is compared with other well known CA models and the ODE based SEIR model. This model fits well with different peaks of COVID-19 data for all the eight countries and can be possibly generalized for a global prediction. Our study shows that the rate of disease spread depends both on infectivity of a disease and social restrictions. Also, it shows an overall decrement in mortality rate with time due to COVID-19 as more and more people get infected as well as vaccinated. Our minimal model with modified neighbourhood condition can easily quantify the degree of social restrictions. It is statistically concluded that the overall degree of social restrictions is above the mean when we considered all eight countries. Finally to conclude, this study has given us various important insights about this pandemic which can help in preparing for combating epidemics in future situations.

Czy epidemiolodzy używają takich modeli?

- I tak i nie. Najpopularniejsze są wciąż modele “ciągłe” oparte o **równania różniczkowe** i **procesy stochastyczne**:

$$\begin{cases} \frac{dS}{dt} = -\beta IS, \\ \frac{dI}{dt} = \beta IS - \gamma I, \\ \frac{dR}{dt} = \gamma I, \end{cases}$$

- więcej chociażby na Wikipedii (https://en.wikipedia.org/wiki/Compartmental_models_in_epidemiology)
- Ale...