

System inference via field inversion for the spatio-temporal progression of infectious diseases: Studies of COVID-19 in Michigan and Mexico

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Keywords: *COVID-19, Compartmental Models, Systems Inference, Computing Methods*

We present an approach to studying and predicting the spatio-temporal progression of infectious diseases. We treat the problem by adopting a partial differential equation (PDE) version of the Susceptible, Infected, Recovered, Deceased (SIRD) compartmental model of epidemiology, which is achieved by replacing compartmental populations by their densities. Building on our previous work [1], we replace our earlier use of global polynomial basis functions with those having local support, as epitomized in the finite element method, for the spatial representation of the SIRD parameters [2]. The time dependence is treated by inferring constant parameters over time intervals that coincide with the time step in semi-discrete numerical implementations. In combination, this amounts to a scheme of field inversion of the SIRD parameters over each time step. Applied to data over 2020 and 2021 for the pandemic in the US state of Michigan and to all of Mexico, our system inference via field inversion infers spatio-temporally varying PDE SIRD parameters that replicate the progression of the pandemic with high accuracy. It also produces accurate predictions, when compared against data, for a three week period.

REFERENCES

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