Acting fast when an epidemic hits: Machine learning predicts short-term disease progression

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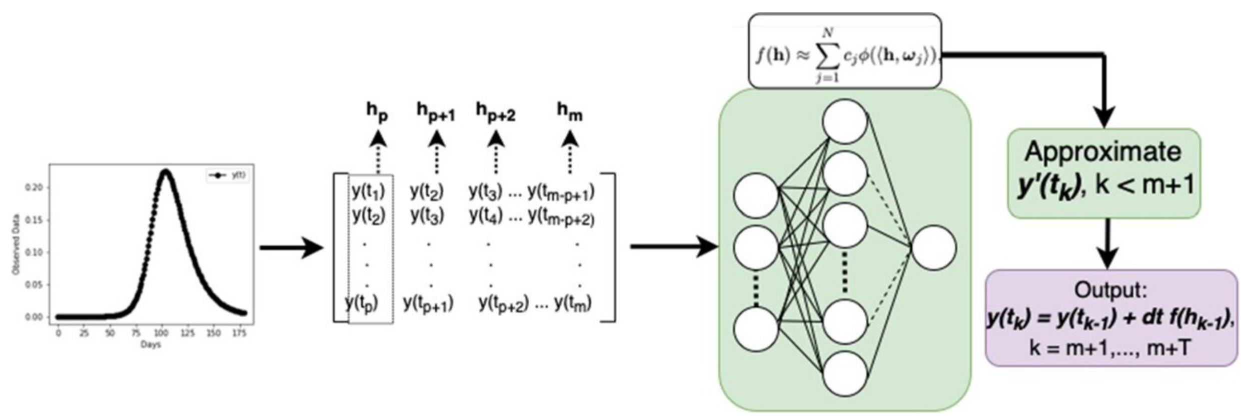

Schematic representation of SPADE4 algorithm. Credit: *Bulletin of Mathematical Biology* (2023). DOI: 10.1007/s11538-023-01174-z

A team of researchers at the University of Waterloo and Dalhousie University have developed a method for forecasting the short-term progression of an epidemic using extremely limited amounts of data.

Their model, the Sparsity and Delay Embedding-based Forecasting model, or SPADE4, uses machine learning to predict the progression of an epidemic using only limited infection data. SPADE4 was tested on both simulated epidemics and real data from the fifth wave of the COVID-19 pandemic in Canada and successfully predicted the epidemics' progressions with 95% confidence. The study, "Spade4: Sparsity and Delay Embedding Based Forecasting of Epidemics," appears in the *Bulletin of Mathematical Biology*.

"COVID taught us that we really need to come up with methods that can predict with the least amount of information," said applied mathematics Ph.D. candidate Esha Saha, the lead author of the study. "If we have a new virus emerge and testing has just started, we have to know what to do in the short-term."

When a disease breakout occurs—whether for new infections like COVID-19 or existing ones like Ebola—being able to predict the development of the disease is essential for making public policy decisions.

"That's what policymakers need right at the beginning," Saha said. "What should we do in the next seven days? How should I allocate resources?"

Traditionally, epidemiologists prefer to build and use complex models to understand the progression of epidemics. These models, however, have several drawbacks, Saha said.

They require complex demographic information that is frequently unavailable at the beginning of an outbreak. Even if that detailed information is available, the models may not accurately reflect the complexity of the population or dynamics of the disease.

The Waterloo research team's new model addresses these drawbacks.

"By the time we're working on vaccines and cures, we're looking at longer-term data," Saha said. "But when a new disease arrives, this method can help give us insight into how to behave."

More information: Saha, E et al, SPADE4: Sparsity and Delay Embedding Based Forecasting of Epidemics. *Bulletin of Mathematical Biology* (2023) doi.org/10.1007/s11538-023-01174-z

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