Modeling transmission dynamics of swine infectious diseases

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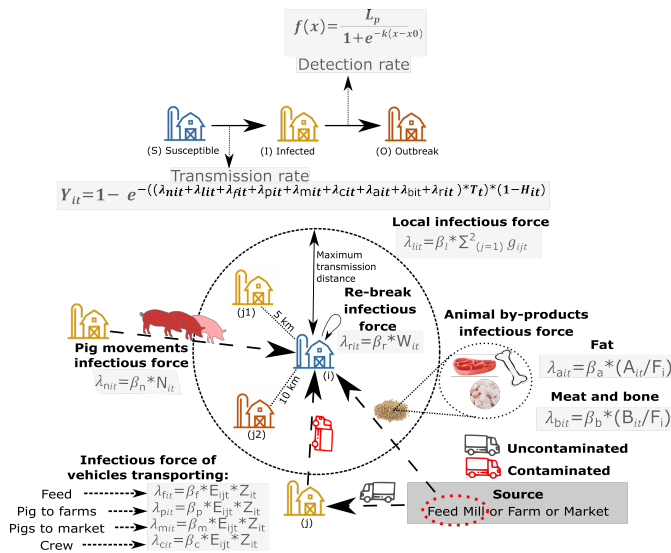✆ *https://machado-lab.github.io/*
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November 13, 2024

Main role: We are searching for a motivated postdoctoral researcher to co-lead the development of a new computational tool for analyzing the spread of swine diseases. This position will be centered on the development of mechanistic models which explicitly consider transmission dynamics in space and time. The focus here is on the development and dissemination of a forecast/prediction treatment regimen for precision and optimal resource allocation to help the swine industry efficiently preempt and manage outbreaks. The postdoctoral researcher will calibrate dynamic mathematical to unique data that has been fully collected and curated.

The available data set includes: actual animal movement data at farm level, weekly disease occurrence with genetic sequences, complete on-farm biosecurity and disease intervention for two years and more. For more details of previous work and data available, read: 1, 2, 3, 4. Models that will be expanded includes the **Pigspread**, and **MHASpread: A multi-host animal spread stochastic multilevel model**

In summary, this work will unravel transmission, estimate epidemic parameters, identify spread determinants, and assess the impact of interventions. In addition, many potential research projects are available and so the research focus may be tailored to the interests and skills of the individual. There will also be opportunities to seek grant funding to develop related, independent research. Access to high-powered computing is available through the Machado's lab Lab website.

$$f(x) = \frac{L_p}{1 + e^{-k(x - x0)}}$$

Detection rate

$$Y_{it} = 1 - e^{-((\lambda_{nit} + \lambda_{lit} + \lambda_{fit} + \lambda_{pit} + \lambda_{mit} + \lambda_{cit} + \lambda_{ait} + \lambda_{bit} + \lambda_{rit})*T_t)*(1 - H_{it})}$$

Local infectious force
$$\lambda_{lit} = \beta_i * \sum_{(j=1)}^{2} g_{ijt}$$

Re-break infectious force
$$\lambda_{rit} = \beta_r * W_{it}$$

Pig movements infectious force
$$\lambda_{nit} = \beta_n * N_{it}$$

Animal by-products infectious force

Fat
$$\lambda_{ait} = \beta_a * (A_{it}/F_i)$$

Meat and bone
$$\lambda_{bit} = \beta_b * (B_{it}/F_i)$$

Infectious force of vehicles transporting:

Feed $\quad\lambda_{fit} = \beta_f * E_{ijt} * Z_{it}$
Pig to farms $\quad\lambda_{pit} = \beta_p * E_{ijt} * Z_{it}$
Pigs to market $\quad\lambda_{mit} = \beta_m * E_{ijt} * Z_{it}$
Crew $\quad\lambda_{cit} = \beta_c * E_{ijt} * Z_{it}$

Source
Feed Mill or Farm or Market

PigSpread overall model structure.

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 Qualifications:
1. The ideal candidate has a Ph.D. degree in a relevant quantitative discipline (computational biology, engineering, ecology, epidemiology, applied mathematics, physics, computer sciences, statistics, or other quantitative fields).
2. Previous experience with multiscale mathematical models will be considered highly.
3. It is critical that the selected candidate have moderate to extensive experience in R or other open-source related statistical software.
4. Previous work related to contact network analysis.
5. Practical experience with building spatially explicit models, particularly those that are also process-based and mechanistic model development.
6. Evidence of original publications in the peer-reviewed literature.
7. Good communication and experience developing grant proposals and taking the lead in projects.
8. Ability to work independently and in collaboration. As part of the position, the candidate will publish and present their work at conferences.

Position terms: The initial appointment will be from 12 to 18 months, but three years of federal funding have already been secured. Salary is expected to be in the range of $65,000, which will be commensurate with the qualifications and experience of the individuals. Travel and health insurance are included. A starting date of June 2023 or earlier is preferred. Screening of applications will begin immediately.

Environment: The Machado Lab develops and deploys epidemiological methods which fully integrate disease evolution, animal movement, and spatial processes to estimate disease transmission and spread. Ultimately, we work in the development of new computational tools for both tracking spread and prescribing non-pharmaceutical intervention regimens. New members will work in a group with a strong background in epidemiology, disease spread modeling, evolutionary epidemiology, social networks, and mathematical modeling. The new member will benefit from the national and international collaboration networks that our lab has developed.

 How to apply: sent to Dr. Machado at gmachad@ncsu.edu the following documents
1. Cover letter with a brief statement of research interests;
2. Curriculum vitae;
3. Sample of scientific writing (e.g., a manuscript in preparation, an undergraduate thesis)
4. Sample of scientific writing (e.g., a manuscript in preparation, an undergraduate thesis), and the names and contact information for two references