

LEMMA_Mvmt_Force

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Purpose

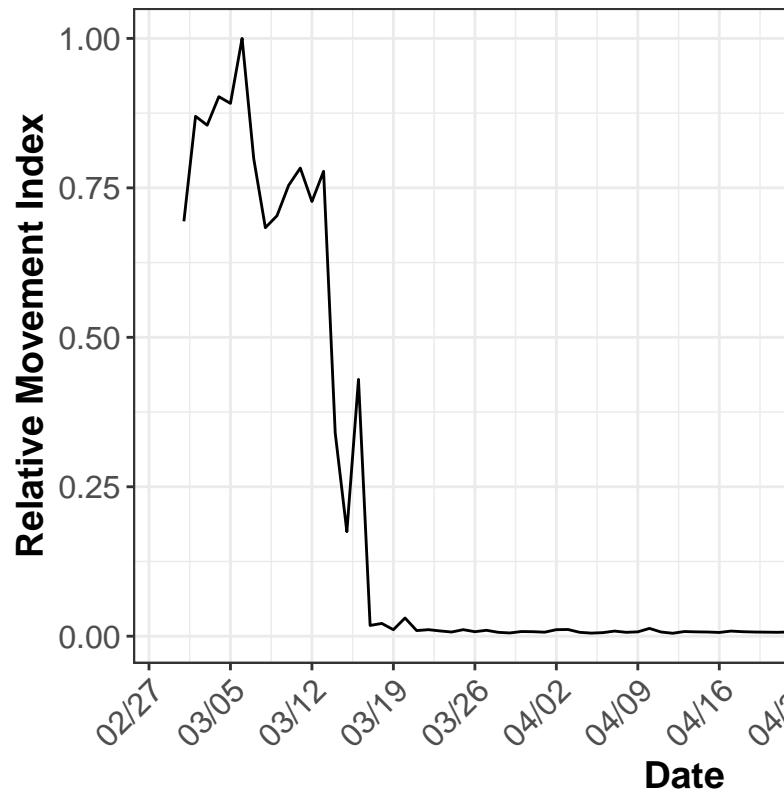
Use movement data incorporated into a dynamic model of COVID transmission via a forcing function to fit early-stage outbreak dynamics and forecast transmission into the future using movement projections.

Movement Data

Descartes Labs

Technical report [here](#). Data represents “the median of the max-distance mobility for all samples in the speci-

Descartes Movement for San Francisco Co



fied region” derived from anonymized mobile phone data.

Table 1: Parameter values and descriptions used in the model

	Value	Definition
N	883305	population size
t.sim	100	time to run simulation
E_0	2	starting number of exposed
β	0.1	transmission rate
c_r	1	Relative contact rate between S and Ir
c_h	1	Relative contact rate between S and Ih
σ	0.25	1/serial interval
α	0.1	proportion severely symptomatic (will be hospitalized)
ρ	0.25	time between symptom onset and hospitalization
γ_r	0.2	1/time to recovery (non-infectiousness) for mildly symptomatic
γ_h	0.083	1/time hospitalized
μ	0.05	proportion of hospitalized cases who die

Epi Data

Model

We use a slight tweak to LEMMA to add an explicit deaths compartment in order to fit to deaths data in addition to hospitalizations

$$\begin{aligned}
\dot{S} &= -\beta S(I_R + I_H)/N \\
\dot{E} &= \beta S(I_R + I_H)/N - \sigma E \\
\dot{I}_R &= \sigma(1 - \alpha)E - \gamma_R I_R \\
\dot{I}_H &= \sigma\alpha E - \rho I_H \\
\dot{H} &= \rho I_H - \gamma_H H \\
\dot{D} &= \gamma_H \mu H \\
\dot{R} &= \gamma_R I_R + \gamma_H (1 - \mu)H
\end{aligned}$$