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Control of an SIR Model for Basic Reproduction Number Regulation

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Abstract : The basic disease-spread model described by three states denoting the susceptible (S), infectious (I), and removed (recovered and deceased) (R) sub-groups of the total population N, or SIR model, has been considered. Heuristic mitigating action profiles of the pharmaceutical and non-pharmaceutical types may be developed in a control design setting for the purpose of reducing the transmission rate or improving the recovery rate parameters in the model. Even though the transmission and recovery rates are not control inputs in the traditional sense, a linear observer and feedback controller can be tuned to generate an asymptotic estimate of the transmission rate for a linearized, discrete-time version of the SIR model. Then, a set of mitigating actions is suggested to steer the basic reproduction number toward unity, in which case the disease does not spread, and the infected population state does not suffer from multiple waves. The special case of piecewise constant transmission rate is described and applied to a seventh-order SEIQRDP model, which segments the population into four additional states. The offline simulations in discrete time may be used to produce heuristic policies implemented by public health and government organizations.

Keywords : control of SIR, observer, SEIQRDP, disease spread
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