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Predator-prey model with SI disease dynamics in predators, increased hunger risk for infected predators, and optimal control strategies

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Abstract. This study presents a novel predator-prey model that incorporates Susceptible-Infected (SI) disease dynamics within the predator population. In this model, infected predators face a higher risk of death due to hunger compared to disease-induced death. We introduce two control variables aimed at reducing disease transmission and mitigating the impact of hunger on infected predators.

The optimal control problem is formulated using a smoothed prey penalty cost function to ensure the prey population remains above a critical threshold, thereby reducing predator mortality. Existence results for the optimal control are established, and numerical simulations illustrate the effectiveness of the proposed strategies.

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