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Optimal Control of the gypsy moth populations

The gypsy moth, *Lymantria dispar (L.)*, is probably the most destructive forest defoliator in the North America. Gypsy moth outbreaks tend to be spatially synchronized over areas across hundreds of kilometers, which can greatly aggravate the ecological and socioeconomic impacts of high density populations and overwhelm management resources allocated to mitigate impacts. Outbreaks can result in loss of timber and other traditional forestry products. Greater losses tend to occur to the ecosystem services that forests provide, such as wildlife habitat, carbon sequestration, and nutrient cycling. Outbreaks can also change the composition of the community, including indirect changes to native herbivores that gypsy moths tend to outcompete and altering forest succession.

The United States can be divided in three different areas: A generally infested area (where gypsy moth populations are established), an uninfested area (populations are not established), or a transition zone between the two. There are different management programs matching these different areas: (1) Detection/ eradication, which targets new colonies in areas uninfested by the gypsy moth (e.g., the west coast of North America), (2) the Slow-the-Spread program, which consists of a barrier zone along the invasion front in the United States, and (3) suppression of outbreaks in areas that are infested by the gypsy moth as a means to mitigate impacts. This work focuses in optimal control techniques for models of areas where the population is established or in the invasion front.

We design an objective functional to minimize the cost generated by the defoliation caused by the population of gypsy moth and the cost of controlling the population with an aerial spray. The objective was to develop an optimal control framework and perform numerical simulations for various scenarios, that seeks to minimize the total cost due to gypsy moth (damage plus control cost).