Dynamic simulation of microalgae cultivation in open raceway pond

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Despite most of commercial-scale microalgae productions carried out in open raceway pond (ORP), only a few ORP models have been proposed to capture complex dynamic behavior of ORP. In this work,, a mathematical model is proposed to describe the dynamics of ORP, which is simple yet accurate. In the proposed model, four major dynamics (microalgal growth, light penetration, sedimentation and heat transfer), which evolve in different time scales are considered. Stiff partial differential equations are used to capture such dynamics. Using a heuristic approach, the original model is decomposed into reduced models, each of which describes the dynamics in different time scales. The reduced models are compared with the original model in terms of accuracy and computation time. Based on the proposed model, optimization problem is formulated to maximize profit using harvest rate and period as the decision variables.