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Remote Monitoring of Growth and Pigmentation in Algal Cultures

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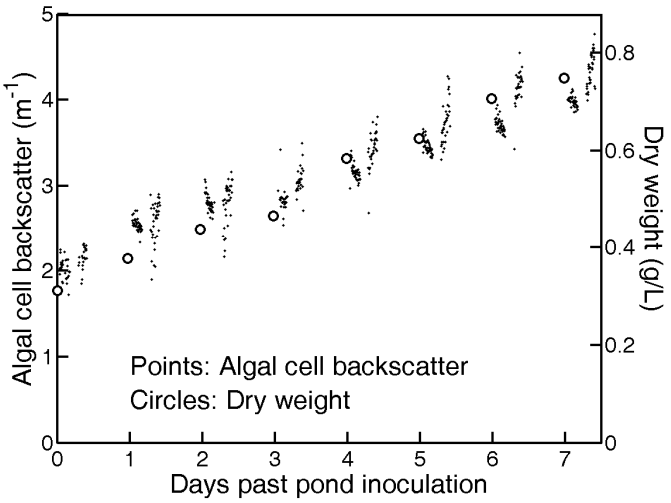
The limited supply and constrained geographical distribution of petroleum based fuels have encouraged the development of renewable sources of energy. Microalgae have long been of interest as a potential source of several different types of renewable biofuels since certain species of algae can accumulate large quantities of biomass and lipids under specific environmental conditions. However, in order to displace a significant portion of petroleum based fuels, algal cultivation must be implemented at a scale that approaches conventional agriculture. Currently, mass cultivation of algae usually occurs in open raceway ponds which are susceptible to contamination from a variety of sources such as pathogens, grazers, viruses, heterotrophs and other algae. Therefore, frequent sampling of algal raceways is necessary not only to determine biomass and lipid productivities but to also identify contamination sources so that mitigation strategies can be implemented. Furthermore, as algal cultivation is scaled up, the physical sampling of each raceway pond to assess its quality becomes economically prohibitive.

Towards obviating the need for frequent pond sampling, we have developed remote spectroradiomteric technology to provide autonomous, real-time, stand-off measurement of the growth rate (mg/m^3-s) and pigmentation of algae and cyanobacteria used in the production of biofuel. The data analysis, based on semianalytical reflectance models developed by the oceanography community, has enabled remote assessment of the optical activity of chlorophyll and carotenoid pigments and the optical depth of culture which correlated closely absorbance spectroscopy of physically extracted samples and dry cell weight measurements. The initial reflectance model was developed for laboratory grown cultures of *Nannochloropsis salina*, and was then extended to the measurement at algal raceways growing organisms akin to *Scenedesmus* and *Spirulina*. The figure below displays the good agreement between the magnitude of the algal backscatter coefficient and dry cell weight measurements of algal biomass for 8 consecutive days of cultivation in an outdoor raceway pond. Spectroradiometric monitoring could provide continuous measurement of the algal biomass and light utilization by the culture at a measurement frequency >10 measurements/hour, a frequency that is incompatible with physical sampling.



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