ID de Contribution: **46** Type: **Non spécifié**

Optimization problem for a microalgal raceway pond to enhance productivity

jeudi 3 décembre 2020 10:30 (30 minutes)

Microalgae are photosynthetic organisms whose potential has been proven in the last decade for several biotechnological applications (e.g.,Y. Chisti. Biodiesel from microalgae, Biotechnology Advances, 2007). These micro-organisms can be massively cultivated in closed or open photobioreactors. In this talk, we focus on the cultivation of algae in a raceway pond, where a paddle wheel is considered to set in motion the water and mix the microalgae (D. Demory et al. How do microalgae perceive light in a high-rate pond? Towards more realistic Lagrangian experiments, The Royal Society, 2018). We consider a coupled physical-biological-mixing model describing the growth of microalgae in raceway ponds cultivation process. Our approach combines a biological model (based on the Han model), shallow water dynamics equations that model the fluid in the raceway pond and a permutation matrix which models a mixing device to exchange the algae layers at each new lap. We present an adjoint-based optimization procedure which includes the constraints associated to the shallow water regime. This approach enables us to deal with the topography and the mixing strategies to maximize the biomass production.

On the contrary to a widespread belief, we show that a flat topography is the optimal in a periodic regime with no mixing strategy. However, non trivial topographies can be obtained associated with some specific mixing strategies (O. Bernard et al. Shape optimization of a microalgal raceway to enhance productivity, Preprint, 2020). We prove that whatever the order of the considered permutation is, the periodic system have a period corresponding to one lap (O. Bernard et al. Optimizing microalgal productivity in raceway ponds through a controlled mixing device, Preprint, 2020). The numerical results show that though non-flat topographies may slightly enhance the production, an appropriate mixing strategies can improve it significantly.

Auteurs principaux: Dr SAINTE-MARIE, Jacques (Inria & Sorbonne Université); Dr SALOMON, Julien (Inria & Sorbonne Université); LU, Liudi (Sorbonne Université & Inria); Dr BERNARD, Olivier (Inria)

Orateur: LU, Liudi (Sorbonne Université & Inria)

Classification de Session: Session parallèle 1