11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
July 20–25, 2014, Barcelona, Spain

OPTIMAL CONTROL OF TWO AGE STRUCTURED MALARIA MODEL WITH MODEL PARAMETER UNCERTAINTY

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Key words: *Malaria, asymptomatic malaria, Optimal control, Parameter uncertainty.*

Mathematical models usually involve parameters which are to be estimated from noisy measurements. Furthermore, a common pitfall for many epidemiological models is the absence of real data; model-based conclusions have to be based on uncertain parameter values, often available from literature only, without reliable uncertainty quantification. These uncertainties propagate into any conclusions based on modeling. Here we study the robustness of optimal control under such parameter uncertainty, using a two-age-classes mathematical model of malaria transmission with asymptomatic malaria carriers. The model incorporates four controls: the use of Long Lasting Insecticide Nets, indoor residual spraying, treatment of symptomatic and asymptomatic individuals. For a given model simulation we generate the synthetic noisy data so that a plausible variability of the epidemiological dynamics is covered. By Markov chain Monte Carlo (MCMC) simulations this variability is mapped to model parameter distributions. The optimal control algorithm is then run using different parameter values sampled from the MCMC parameter posterior. Here we study different ways of implementing this approach and demonstrate by numerical simulations the robustness of control: the main conclusions of the optimal control remain unchanged, even if inevitable variability remains in the control profiles provided that there is effective control scenario. The results provide a promising framework for the designing of cost-effective strategies for disease controls with multiple interventions, even under considerable uncertainty of model parameters.