Bayesian Estimation of the parameters of packed-bed drying process of biomass

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Biomass is getting more an more popular since it is treated as a renewable source of energy. Its utilisation covers direct utilisation as a fuel in the furnaces or indirect utilisation as a substrate for the syngas production in pyrolysis or gasification processes. However, to increase the effectiveness of any possible method of biomass utilisation its needs to be dried. In this paper biomass drying process in a packed-bed is analysed. Such a packed-bed can be successfully treated as a porous medium. The porous medium can be considered as a solid material (solid matrix) containing interconnected voids which might be partially or completely filled with a fluid. This definition includes a wide range of substances used in the modern industry, as well as encountered in nature or artificial materials. The widespread occurrence of porous materials in every-day life and their interesting properties are causing intensive research in this subject. The paper considers estimation of parameters of a drying process of biomass. Especially, parameters describing flow through porous materials, like porosity, pore diameter, permeability, tortuosity, etc., as well as parameters describing evaporation kinetics are of special interest.

This paper deals with the Bayesian estimation of chosen flow parameters in a porous material based on pressure drop and local temperature measurements at chosen points inside the packed-bed. The unknown distribution of estimated parameters was sampled using Markov Chain Monte Carlo (MCMC) method [1]. However, the MCMC method is efficient in sampling unknown distributions; it is extremely time-consuming. To decrease the computational time necessary to generate an ergodic Markov Chain, Proper Orthogonal Decomposition was used to construct off-line, low order approximation of the porous media flow problem. This model was further incorporated into the Metropolis-Hastings algorithm to retrieve the posterior distribution of unknown parameters. The error of the reduced model was incorporated in the form of the uncertainty distribution into the posterior distribution of unknown parameters.

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