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In this article we consider using a class of α-stable processes, which can be regarded as generalizations of the Gaussian processes, as the surrogate models for uncertainty quantification. We introduce a class of α-stable processes, whose finite dimensional distributions can be represented using independent stable random variables. This representation allows for Bayesian inference for the proposed statistical model. We can obtain the posterior distributions for the untried points as well as the model parameters through an MCMC algorithm. The computation for the representation requires some geometrical information given by the design points. We propose an efficient algorithm to solve this computational geometry problem. Two examples are given to illustrate the proposed method and its potential advantages.