MARKOV CHAIN MONTE CARLO (MCMC) METHODS FOR THE PARAMETER ESTIMATION OF A NOVEL HYBRID REDUNDANT ROBOT

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This paper presents a statistical method for the calibration of a redundantly actuated hybrid serial-parallel robot IWR (Intersector Welding Robot). The robot under study will be used to carry out welding, machining, and remote handing for the assembly of vacuum vessel of the ITER reactor. The robot has ten degrees of freedom (DOF), among which six DOF are contributed by the parallel mechanism and the rest are from the serial mechanism. This kind of structure can combine both advantages of the serial and parallel mechanisms together to satisfy the practical requirement, but due to the redundant degrees of freedom and structures, it is very difficult to identify the geometrical errors by using conventional calibration methods. In this paper, a kinematic error model which involves 54 independent unknown and immeasurable geometrical error parameters caused by the manufacturing and assembly processes is developed for the proposed robot. Based on this error model the mean value of the unknown parameters are statistically analyzed and estimated by means of Markov Chain Monte Carlo (MCMC) approach. The MCMC algorithm has advantages in solving high nonlinear problems and obtaining probability distributions with noise-corrupted physical data, which is very suitable for the study of our proposed robot, meanwhile, it also can be adopted to the robot calibration of similar structure. In this article, the simulation is conducted by introducing random geometric errors and measurement poses which represent the corresponding real physical behaviours. The validity and effectiveness of the MCMC approach for the proposed application is also examined, and the results of the marginal posterior distributions of the estimated model parameters are shown in figure 1.

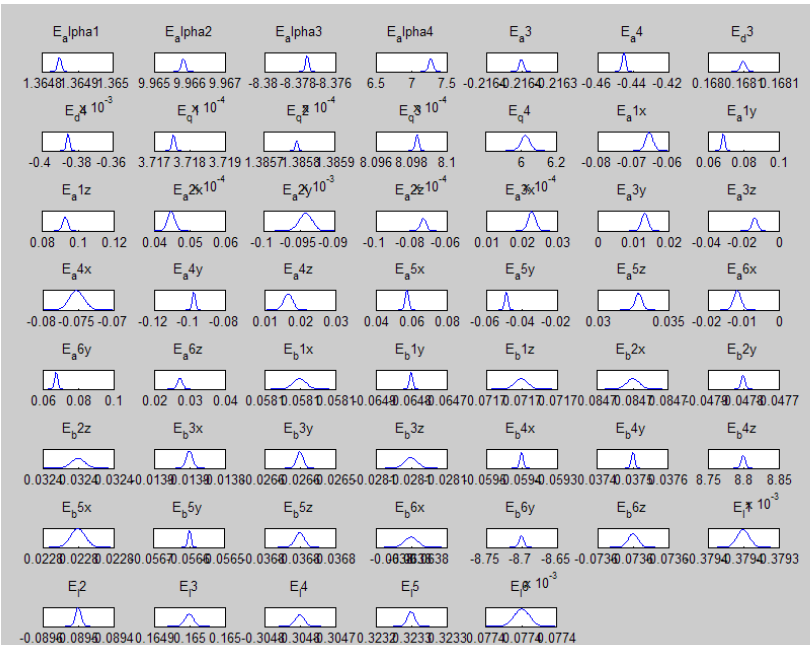

Figure 1: marginal posterior distributions of the estimated model parameters