Langevin and empirical Bayesian imaging methods

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We first introduce the Bayesian modelling paradigm and then quickly progress to fundamental concepts of Bayesian decision theory that are relevant to imaging sciences, such as point estimation and uncertainty quantification analyses, hierarchical and empirical approaches to calibrate unknown model parameters, and model selection. This is then followed by an introduction to efficient Bayesian computation approaches. We pay special attention to methods based on the overdamped Langevin stochastic differential equation, to proximal Markov chain Monte Carlo algorithms, and to stochastic approximation methods that intimately combine ideas from stochastic optimisation and Langevin sampling. These computation techniques are illustrated with a series of imaging experiments where they are used to perform some of the advanced Bayesian analyses previously introduced.