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Decision sensitivity for engineering applications with epistemic uncertainty

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Decision sensitivity measures, specifically *information values*, quantify the effect of input uncertainty on the optimality of a decision taken based on a predictive model. The information value of an input X is the expected value of partial perfect information associated with making a better decision when learning X. The information value has become popular mainly in the field of medical decision-making, but it is also a natural sensitivity measure in engineering, where models serve the purpose of making decisions about design, operation, retrofitting, upgrading or decommissioning of systems. In this contribution, we focus on decision sensitivity for engineering applications and discuss the modeling of decisions and the associated utility function (or scoring rule). We then focus on the separation of aleatory and epistemic uncertainty in engineering applications and investigate the implications of this separation on the interpretation of the sensitivity measures. We also discuss strategies for computationally efficient sampling-based estimation of the information values under aleatory and epistemic uncertainty. We illustrate the theory using two real-life applications concerned with the site selection for a nuclear waste deposit and the optimization of flood protection measures.

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