Uncertainty in Support Vector Regression with Hyperparameter Tuning and Applications to System Degradation Modeling and Risk Assessment

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**ABSTRACT:** Data-driven learning methods for predicting the evolution of degradation processes affecting systems are becoming increasingly attractive in reliability and prognostics applications as well as in risk analysis. Among these, Support Vector Regression (SVR) has provided promising results in various applications. Current techniques however lack some important features for effective real world use in reliability and risk-informed decision-making. For instance, the predictions provided by SVR are point estimates whereas credible risk and reliability applications require explicit treatment of uncertainties. A boostrapped SVR has been developed to obtain confidence and prediction intervals, without having to make any assumption about probability distributions and with good performance even when only a small data set is available. In addition, the methodology includes stages of hyperparameter tuning and variable selection by means of Particle Swarm Optimization (PSO) with SVR. Two applications are provided. The first case is a Reliability Engineering application where the method is employed to predict the remaining useful life of intelligent control valves (ICV) for offshore oil wells operating in scale-forming conditions. The second case is a Risk Analysis application involving prediction of surface meteorological variables in certain extreme environmental events that influence the risk of some tropical diseases (e.g., Dengue Fever).

**BIO:** Enrique López Droguett is associate professor in the Production Engineering Department and director of the Center for Risk Analysis, Reliability and Environmental Modeling at the Federal University of Pernambuco, Brazil. He conducts research on methods for probabilistic risk analysis and reliability of systems, uncertainty of analysis, Bayesian methods, maintenance optimization and ecological risk assessment. He has led many major studies on risk and reliability of complex systems such as oil and gas exploration and production, oil refineries, commercial aviation, and hydropower plants. Dr. Droguett received his Ph.D. in Reliability Engineering from the University of Maryland at College Park in 1999.

For more information: Kimberley Frye (kfrye@umd.edu)