Problem statement

The residual life (RUL) represents the remaining operating time of a component or a system before its failure date. This value is an important factor to consider when scheduling maintenance operations. In general, the RUL is estimated using data obtained from deterioration measurements up to the current moment. However, because of sensors's imperfection and the impact of the working environment, the monitored data are often contaminated. This raises difficulty for diagnosis (retrieving the current level of degradation) and, consequently, prognosis (predicting the future evolution of the degradation state). To address such a problem, this study pays particular attention to the use of the particle filter technique.

Using sequential Monte Carlo method, the particle filter is an implementation of recursive Bayesian estimation. The idea is to estimate at each time (t), the *a posteriori* distribution $p\left(x_t \mid Y_t\right)$ of the degradation level by a discrete distribution formed by a set of samples with their associated weights, which we call under the term *particles* $\left\{x_t^i, \mathrm{W}_t^i\right\}_{i=1}^{N_s}$. According to the law of large numbers, when the number of samples is large, they characterize well the *a posteriori* distribution. Once the *a posteriori* distribution has been obtained, we can estimate the actual level of degradation (x_t). Finally, after estimating (x_t), the calculation of the RUL is performed using simulation.