In this paper, the motor current/voltage signature analysis and linear discriminant analysis (LDA) are evaluated with respect to the accuracy to detect the status of permanent magnet synchronous machines (PMSMs) whether it is healthy or faulted, determine the type of that fault, and estimate the severity in the case of static eccentricity or turn-to-turn short-circuit fault. Three types of faults are discussed: static eccentricity, turn-to-turn short circuit, and partial demagnetization fault. Two-dimensional finite element analysis (FEA) is used to model and simulate the machine under healthy and faulted conditions. Fast Fourier transform is applied to the phase voltage or current signals to obtain the frequency spectrum. A combination of the amplitude of the harmonics of the stator voltage or current signals are used as detailed features for the classifier for fault detection. LDA is chosen as a classification method for both detecting the fault and estimating its severity. Two different winding types of PMSMs are tested: a concentrated and a distributed winding machine. To validate the simulation results, experiments at different operational points are carried out and the results are compared with the sFEA.