In this master's thesis, we provide a brief introduction to Josephson junctions and machine learning algorithms. We analyze the phase dynamics of Josephson junctions, notable for their significant second harmonic in the current-phase relationship. Initially, we generate data by simulating stochastic dynamics. We then investigate two aspects: determining occupation probabilities from the distribution function and detecting and categorizing anomalies (phase jumps) in a velocity spectrum. We determine that the random forest algorithm is the most effective model for calculating occupation probabilities from distribution functions. Anomaly detection is achieved without the need for machine learning, thanks to effective preprocessing of the velocity evolution. We then analyze two characteristics of detected anomalies: the number of maxima which they cross and the initial and final positions of the particle with respect to two minima in a potential. For determining each characteristic, we employ supervised learning, requiring only one hidden layer with 32 neurons.

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1 Introduction