論 文 の 内 容 の 要 旨
Abstract

論文題目　　Detecting Model Changes and their Early Warning Signals with the Minimum Description Length Principle
（記述長最小原理に基づくモデル変化と早期警戒信号の検知）

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　　　　The growing importance of data utilization has resulted in its promotion; thus, acquiring potential knowledge from data based on mathematical models is gaining attention. In this study, we focus on non-stationary data for data utilization and aim to develop a technology to detect changes in the structure of a dataset based on a uniform standard. We adopt the minimum description length (MDL) principle for the concept of uniform standard and propose algorithms based on the normalized maximum likelihood (NML) code length. This code length achieves the minimum Shtarkov's minimax risk and minimax estimation optimality. First, we propose new indices for measuring the complexity of a dataset using parametric and nonparametric models. In the parametric model, we propose structural entropy (SE), which indexes the uncertainty of the results when selecting a model. In the nonparametric model, we propose kernel complexity (KC), which indexes the concentration of data chunks. Next, we propose new methods for detecting change points and their early warning signals using these indices. In the parametric model, we propose an algorithm using SE as an index and another algorithm using sequential MDL change statistics (SMCS) to express the degree of change. In the nonparametric model, we propose an algorithm using KC as an index. Last, we analyze the efficiency of the proposed indices (SE, SMCS, and KC) in detecting changes using synthetic and practical datasets.