An Adaptive Parameter Setting Technique for the Possibilistic Fuzzy c-Means Clustering Algorithm

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C-means clustering algorithms employing fuzzy partitions have two basic approaches. Chronologically the first, introduced by Dunn [1] and generalized by Bezdek [2] uses a probalilistic partition, and is called the fuzzy c-means (FCM) clustering model. Alternatively, the so-called possibilistic c-means (PCM) algorithm, introduced by Krishnapuram and Keller [3], relaxed the probabilistic constraint of the partition matrix and uses fuzzy membership functions that describe the compatibility of data vectors with the c clusters. The irony in the terminology is that PCM is more fuzzy than FCM.

Since both basic approaches have shortcomings in their behavior, mixed clustering methods were proposed, which were desingned to attenuate the unwanted phenomena. The most well-known mixed c-means clustering algorithm is the possibilistic-fuzzy c-means model proposed by Pal et al. [4], which combines the probabilistic and possibilistic components of the partition matrix as a linear combination.

This paper presents an alternative formulation of the PFCM clustering model, which allows for the adaptive tuning of the so-called possibilistic penalty terms of the algorithm. This way the user needs to set a reduced number of parameters, which makes the algorithm easier to handle. The proposed solution is inspired by the cluster size controlling version of the FCM algorithm proposed by Miyamoto and Kurosawa [5], and the self-tuning version of the PCM algorithm proposed by Szilágyi et al [6]. Numerical tests revealed that the proposed adaptive PFCM algorithm produces slightly better clusteing results in terms of partition quality indicators like cluster purity, normalized mutual information, and adjusted Rand index.

References

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