SSFCM was proposed by Pedrycz and Waletzky in 1997 as a semi-supervised extension of FCM, which enhances the clustering procedure by injecting the class labels' prior knowledge into the FCM. In SSFCM, the data is considered a union of labeled instances, and unlabeled instances, where , and refers to the count of all data instances. Adopting the same principles as FCM, a membership degree matrix is considered, which indicates the membership degree of the th sample to the th cluster, and obeys the same membership constraints as FCM (). Accordingly, the objective function of the SSFCM approach is defined as:

|  |  |
| --- | --- |
|  | (1) |

In Eq. (1), the second term represents the prior supervised knowledge, in which, is an -dimensional label indicator vector, with for labeled samples, and for unlabeled samples. corresponds to the fuzzy degrees of the labeled samples in which if sample belongs to the class , and 0 otherwise. Finally, is the regularization parameter.

Adopting the Lagrange multipliers approach, the membership degree of sample in cluster () is computed as follows.

|  |  |
| --- | --- |
|  | (2) |

For cluster , the cluster center is computed according to Eq. (3).

|  |  |
| --- | --- |
|  | (3) |