Analyzing Instability of Industrial Clustering Techniques

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Abstract
The process and hybrid LCA methods have a crucial problem such that the LCA system boundary is freely decided by LCA practitioners, which consequently leads to truncation error and underestimation of life-cycle emission. This paper focuses on clustering methods (eigenvalue decomposition of the normalized Laplacian matrix and nonnegative matrix factorization of the normalized affinity matrix) which are useful in determining the LCA system boundary and investigates the instability of the clustering methods. The results indicate that, in cases involving a relatively small number of K-means repetitions (approximately 10), choosing the nonnegative matrix factorization method over the eigenvalue decomposition method yields smaller values of “normalized cut” value Ncut (an indicator showing the goodness of network partitions), the benchmark indicating optimal cluster assignment. On the other hand, for a larger number of K-means repetitions (100 or more), neither method is universally superior to the other.

Keywords: LCA system boundary, CO2 intensive clusters, clustering analysis, input-output analysis, discrete optimization.