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Weight Estimation Using the K-Means Method in Steelmaking's Overhead Cranes in Order to Reduce Swing Error

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Abstract : One of the most important factors in the production of quality steel is to know the exact weight of steel in the steelmaking area. In this study, a calculation method is presented to estimate the exact weight of the melt as well as the objects transported by the overhead crane. Iran Alloy Steel Company's steelmaking area has three 90-ton cranes, which are responsible for transferring the ladles and ladle caps between 34 areas in the melt shop. Each crane is equipped with a Disomat Tersus weighing system that calculates and displays real-time weight. The moving object has a variable weight due to swinging, and the weighing system has an error of about +-5%. This means that when the object is moving by a crane, which weighs about 80 tons, the device (Disomat Tersus system) calculates about 4 tons more or 4 tons less, and this is the biggest problem in calculating a real weight. The k-means algorithm is an unsupervised clustering method that was used here. The best result was obtained by considering 3 centers. Compared to the normal average(one) or two, four, five, and six centers, the best answer is with 3 centers, which is logically due to the elimination of noise above and below the real weight. Every day, the standard weight is moved with working cranes to test and calibrate cranes. The results are shown that the accuracy is about 40 kilos per 60 tons (standard weight). As a result, with this method, the accuracy of moving weight is calculated as 99.95%. K-means is used to calculate the exact mean of objects. The stopping criterion of the algorithm is also the number of 1000 repetitions or not moving the points between the clusters. As a result of the implementation of this system, the crane operator does not stop while moving objects and continues his activity regardless of weight calculations. Also, production speed increased, and human error decreased.

Keywords : k-means, overhead crane, melt weight, weight estimation, swing problem
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