Classification of Wear Mechanisms Using Artificial Intelligence

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Understanding the acting wear mechanisms in many cases is key for predicting lifetime, developing models describing component behavior or for the improvement of performance of components under tribological loading. Conventionally Scanning-Electron-Microscopy (SEM) and sometimes additional analytical techniques are performed in order to analyze wear appearances, i.e. grooves, pittings, surface films, and others. In addition, experience is required in order to draw the correct and relevant conclusions on the acting damage and wear mechanisms from the obtained analytical data. E.g. differences in the degree of plastic deformation or chemical changes in the surface material are sometimes challenging to characterize and observe, but may have a distinctive influence not only on wear, but also on the acting friction. Until now, different types of wear mechanisms are classified by experts examining the damage patterns manually. In addition to this approach based on expert knowledge, the use of artificial intelligence (AI) represents a promising alternative. Here, no expert knowledge is required, instead the classification is done by a purely data-driven model. In this contribution, different approaches are discussed, whereas artificial neural networks represent the AI-based models. Both forces recorded during tribometer sliding wear tests on steels, as well as SEM images of the wear appearances obtained from such experiments are used as the data base. In order to obtain an optimal performance of the artificial neural networks, a hyperparameter optimization is performed in addition. Among others, the number of layers, the number of neurons and the type of activation functions within the neurons are considered. The content of this contribution is the investigation of the feasibility of an AI-based model for automated classification of wear mechanisms.

Keywords: Artificial Intelligence, Classification, Wear Mechanism, Sliding Wear.

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