**Data Processing and Explanation for "Flank Wear of CNC Lathe Tool Insert Dataset"**

**Important Statement**

This dataset is derived from the processing of the "Flank Wear of CNC Lathe Tool Insert Dataset," including removing outliers and duplicates. If you wish to refer to the original dataset, please visit the URL: https://www.kaggle.com/datasets/drganeshkumars/flank-wear-of-cnc-lathe-tool-insert-dataset.

**Data Description**

The dataset documents flank wear of CNC lathe tool inserts. Flank wear, a detrimental phenomenon in single-point cutting processes, arises from adhesion and abrasion when the cutting tool contacts the workpiece. It is measured by distinguishing geometric relationships in rake face images between new and worn tools.

Flank wear of lathe tools impacts machining quality: it degrades surface finish, increases tool replacement frequency, reduces machining efficiency, and may cause dimensional errors affecting overall precision. Tool wear is primarily influenced by Feed Rate, Depth of Cut, and Cutting Speed during turning, as summarized in Table 1. Establishing mathematical relationships between these physical variables and flank wear serves as the foundation for intelligent optimization of cutting parameters.

Table 1 Key Factors Influencing Flank Wear of Lathe Tools

|  |  |  |  |
| --- | --- | --- | --- |
| Category | Physical Variable | Symbol | Description |
| Input | Feed Rate | fr | Distance the tool travels per unit time along the machining direction, affecting machining efficiency and surface roughness. |
| Depth of Cut | dec | Vertical thickness of material penetrated by the tool in a single pass, determining material removal volume and directly correlating with cutting force. |
| Speed | sp | Linear velocity at the contact point between the tool edge and workpiece, characterizing friction and heat generation intensity during cutting. |
| Target | Flank Wear | fw | Material loss on the tool flank due to friction with the workpiece, impacting machining precision and surface quality of parts. |

The dataset contains 2001 samples without missing values. However, 45 samples were incorrectly recorded as negative or excessively large values (physically meaningless for flank wear measurement) and were thus removed, leaving 1956 samples for experiments.