

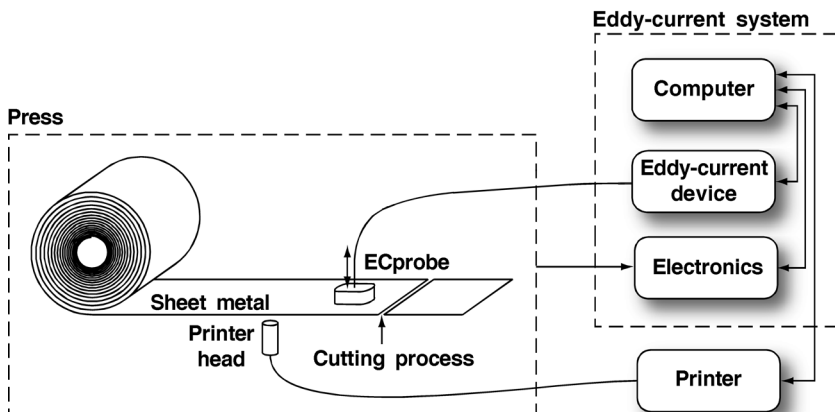
1.2.18. ONLINE ACQUISITION OF MECHANICAL MATERIAL PROPERTIES OF SHEET METAL FOR THE PREDICTION OF PRODUCT QUALITY BY EDDY CURRENT

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In industrial sheet metal forming processes several factors influence the quality of the produced parts. These are the raw material, the tooling, the press settings and the environment. The variations of these parameters, although they are inside of the specified tolerances can cause defects in the manufactured part or product. Especially in the automotive industry the press shops face several challenges: The design cycles are shortened, the body shell parts of the cars are increasingly complex but they nevertheless need to be manufactured with high accuracy and no rejections at low cost.

In this work, the focus is on the variations of the material properties (yield strength, ultimate strength, uniform elongation and fracture elongation), because they can change very fast and become evident only when defects in the manufactured parts are detected. Systems are required to eliminate or compensate the variations of material properties online during production. This can be done either by sorting out inapplicable material or by adjusting the parameters of the forming process to the material properties. A system for the non-destructive measurement of mechanical properties and the identification of inappropriate material in production is presented.

As it is well known, the microstructure of a material has an impact on the mechanical as well as the electromagnetic properties and a correlation between these properties exists. A multifrequency eddy current device is used to obtain a fingerprint of the inspected material. The acquired eddy current data then are combined with intelligent data mining algorithms to generate a mathematical model that represents the correlation between the mechanical and the electromagnetic properties of a material with sufficient accuracy. The system was installed in the press shop of a car manufacturer and used to measure the mechanical properties during production. The figure below shows the setup of the complete system as it was used for the online measurements.



The characteristics of several coils were measured and a 100% monitoring was achieved. The validation of the mathematical model showed high accuracy, between 2 and 4%, depending on the mechanical property. During the measurements in the press shop several blanks for comparative measurements were collected and very good agreement between the calculated values and the tensile test was found.

The achieved accuracy of the introduced measurement system is sufficient to acquire data that can be used in the press shop to sort out inappropriate material or to adjust the press settings for the forming process to achieve less scrap. When the system is installed in the press shop, it can also be used to generate a database for sensitivity analysis in the tool shop for draw die development.