EXPERT SYSTEM FOR ROLLING LOAD PREDICTION IN 20 HI SENDZIMIR MILL

Dr. R. S. Hingole
Working as Professor and Head PG, Department of Mechanical Engineering, G H Raisoni College of Engineering and Management Wagholi, Pune, Maharashtra State, India

ABSTRACT

To meet the challenges of international competition a rolling mill must be able to produce high quality products cost effectively. The optimization of production and product quality is possible when the effect of each process parameter on process performance and the product properties is known. Presently, the process control parameters are based mainly on mathematical and statistical models changing product properties or process parameters, or the introduction of a new steel grade may, however, require tedious recalculations or even experimental tests that are both expensive and time-consuming. By using neural, artificial intelligence, fuzzy control most of computing and related work can be avoided. There are also many process steps for which exact mathematical models do not exist, and the process is affected by the human behavior of the operator. This research is focused on developing a new system that combines an expert system with rolling process. The web based expert system for rolling operation is implemented in a novel way. The World Wide Web is used as the platform for the online rolling operation and it offers several advantages to the conventional stand-alone approach. The result presented in this research paper can thus be used as basic to provide solution for practical usage.

Keywords: Cold rolling, expert system

1. INTRODUCTION

In sheet metal forming, it is vital to strictly prevent surface defects like wrinkling so as to ensure dimensional accuracy and acceptable aesthetics. Traditionally, prototype and small batch production shops have been limited to competing locally for customers; however, the connectivity of the Internet and World Wide Web now allows manufacturers to offer their services globally for the first time. Some manufacturers have already utilized this strategy for various manufacturing processes, but no one has yet offered sheet metal forming operations over the Internet. Another trend in industry has been the use of expert systems to aid designers in different aspects of the design phase. The task of matching product features with process capabilities and studying the tradeoffs inherent in using different processes to produce the same part are some of the most difficult a designer faces. Expert systems are being used increasingly in manufacturing and it is estimated that by the year 2000 there will be two to four
applications of expert systems in every manufacturing company, regardless of size. This research expands on these ideas by creating a expert system on the World Wide Web that will guide designers through the process of matching the desired part features with the best or preferred rolling process to produce variety of features. Simulations will be incorporated into the rolling process to aid in determining the final part characteristics. Initially, our research will focus on sheet metal forming operations basically rolling process. Web based expert system for rolling load prediction in 20 Hi Sendzimir mill is successfully implemented. The details of the rolling process and its parameter are discussed. The case study based on expert system is presented in this research work.

2. LITERATURE SURVEY
In recent years, attention has focused on the development of level II systems that work hand-in-hand with level I systems. Several advanced level II rolling mill set-up systems have been developed\(^1\). In addition to using classical mill set-up models, some advanced model adaptation techniques have been adopted in level II control\(^5,7\). Expert systems and knowledge-based applications have grown, impacting many areas of decision making (especially in manufacturing) such as dynamic scheduling, production planning, quality management, plant layout, advanced manufacturing processes, process optimization, purchasing and materials. Integrated reasoning systems have been implemented to improve the quality control in a rolling mill. Artificial Intelligence techniques have been used in mill set-up systems\(^8,11\). The paper describes the design, implementation and testing of an intelligent knowledge-based supervisory control (IKBSC) system for a hot rolling mill process. The results from the trials demonstrate the advantages to be gained from the IKBSC system that integrates knowledge contained within data, plant and human resources with existing model-based systems\(^12, 13\). In the present study, the results obtained from the present study can be used to establish a database for looper control in hot rolling processes by determining the effect of the front and back tensions and selected process parameters on the maintenance of the uniformity of the strip thickness. Through this study, the capability and usefulness of fuzz application in thickness control in hot rolling was clearly demonstrated\(^14,15\).

3. FORCES IN THE ROLL GAP
A piece of metal of thickness \(h_1\) and width is passing into rolls with at velocity \(v_1\). The gap between roll is such that thickness is reduced to \(h_2\) at the point nearest approach and the velocity of metal leaving the roll is \(V_2\). The width is assumed to be constant for simplicity, but in practice there is always spread and \(w_2\) is greater than \(w_1\). The velocity of the roll surface which is normally constant, must lie between \(v_1\) and \(v_2\). The rolling load is estimated as

\[
R_L = \delta \times w \times \sqrt{r \times h} \left[1 + \mu \times \sqrt{r \times h} \times \frac{h-\delta}{h/2}\right]
\]

The web based expert system has been implemented for the estimation of rolling load prediction in Sipta Commet Steel Limited, Nanded, Maharashtra State, India. This has implemented to conclude that meet the changes that are certain to take place in industry. The material supplier need to low commitment and flexibility. The major aim of this research work to provide the wide variety of rolling information to save energy to
improve the productivity. The application of it find diverse area such as automobile and automobile component, refrigerator, air conditioners, bicycles, containers, bearings, electronics sections, domestic applications.

4. A CASE STUDY
Sipta Commet Steel Limited, Nanded, Maharashtra Sate is one of the well known rolling industry in India. The major work carried out in this industry is based on the cold rolling. The 20 Hi Sendzimiar Mill has been used for reduction of varieties plate thickness. The expert system has been successfully implemented for load prediction in this plant for 20 Hi Sendzimiar Mill. The determination rolling load is very important in this study. The plate having thickness 8 mm has to reduce up to 5 mm slab when friction ($\mu$) given is 0.08 and the roll radius is 20mm. The stress is 25 N/mm$^2$. This is initial information provided to expert system. On the front line of the Web site are the Web servers that act as the presentation tier on which client has to put initial information. Web Servers dynamically format content as HTML, Applet or JSP to be displayed by Web browsers. All the business logic of the system resides in the application servers that act as application tier. Application Servers receive requests from Web servers, look up information in databases and process the requests. The processed information is then passed back to the Web servers where it is formatted and displayed. The final result on client side can get as the rolling load prediction in 20 Hi Sendzimiar Mill is 7308.26N, Torque is 102315.167 and Power is 3.68 KW. This are verified with the actual result of rolling mill. Thus this expert system is developed in naval way.

5. TEST RESULT AND DISCUSSION
The working of client server we based expert system analysis application is shown in Fig. 1 and Fig. 2. Initially you can find and view information about sheet metal forming on web site address http://sggs.ren.nic.in:8080/prod/project/rolling user can find out required information about cold rolling process. After this user can view the cold rolling specifications. Now user has to enter specification. On receiving the request from the client, the server formulates the cold rolling analysis and sends to back the result to client so that the user can view them. Thus the web based expert system has been used to demonstrate the application of cold rolling process.

![Fig.1. Web page of cold rolling specification](image-url)
6. CONCLUSIONS
This research paper presents the development of a World Wide Web-based expert system for cold rolling process. This expert system gives the analysis result of the cold rolling process. In this system client have to enter the input specification like stress, width, friction, radius, initial and final thickness, moment of arm. After this the client request goes to the server side where expert is available. This expert system provides the required analysis of cold rolling process. Finally it gives the output result such as torque, power, rolling load. In this way this expert system is successfully implemented for cold rolling process. Thus this expert system is very helpful in the cold rolling industries.

REFERENCES
9  M. Gams et al., (1997) Integration of multiple reasoning systems for process control, Engineering Applications of Artificial Intelligence 10 (1) 41–46.
14  Jong-Jung, Yong, (1999) Fuzzy control algorithm for the prediction of tension variations in hot rolling, JMPT 163±172.