ABSTRACT

Boring is an important machining process commonly found in all types of industries. It is basically a finishing operation in which the dimension of the part being machined is precisely controlled.

Surface roughness is an important quality parameter of the bored surfaces which directly affect on the functionality of the mating surfaces. Today's machines are not equipped with automatic control of machining parameters during operation. Hence it was proposed to develop a suitable technique for on-line monitoring of surface roughness and its control by controlling the machining parameters. It was also proposed to optimize the values of the machining parameters to enhance the material removal rate and hence to reduce the machining time. Machining center was considered for analysis as it is being used for mass production. The problem proposed is having direct relevance to the industry. More than 750 research papers having direct relevance to boring process were studied in order to analyze the mechanics of boring process in particular.

To investigate the correlation between different variables numerous cutting trials were conducted. Samples of AISI C1041 with internal diameter 85 mm, outside diameter 105 mm and length 75 mm were used as a work pieces. Standard boring bar of 16mm, 20mm and 25mm diameters were used as cutting tools. In few cutting trials a specially designed boring bar was used. During the initial part of experimentation, the conventional lathe machine was used to cut the material. The vibrations were measured in radial, tangential and axial directions by using B & K make accelerometers and OROS make FFT analyzer and its variation with respect to cutting parameters were studied. The surface roughness was measured using standard stylus type profilometer. The part of experimentation was done on CNC lathe machine.

In the present work an attempt is made to find the correlation between acceleration of the boring bar and corresponding surface roughness. It was also tried to find the variation of these two parameters with the variation in cutting parameters. From the number of experiments conducted for various combinations of machining parameters, it was found that there exists a good correlation between the boring bar acceleration and
its corresponding surface roughness. It was however also possible to control the acceleration of boring bar and hence surface roughness by controlling the values of machining parameters. On-line measurement of surface roughness is not possible while that of boring bar vibrations is possible. Hence a correlation between the two will give a break-through for on-line measurement and control of roughness.

It was proposed to develop an automatic control system which will monitor the boring bar vibrations during the metal cutting. An algorithm was developed for automatic control of boring bar vibrations by controlling the machining parameters. The system was then modeled and simulated by using the Simulink tool of MatLab. The proposed technique was found to be feasible for its practical implementation.

An attempt was also done to develop a micro-processor controlled prototype model of machine which will work on the technique proposed here. The technique of measuring the surface roughness by measuring the boring bar vibrations was found to be very useful for optimization of cutting parameters in order to increase the productivity of the machine tool.