Abstract

A method of tracking surface modification due to phenomenon like abrasive wear by using *bondgraphs* has been presented in this study. The hitherto unexplored area of centreless grinding of balls used in antifriction bearings has been modelled using these ideas. Centreless Grinding is a major mass manufacturing technique for production of objects with cylindrical or spherical symmetry. The process belongs to that class of rarities which offer the combined benefits of quality assurance along with large production volumes and amenability to automation. The rolling elements of antifriction bearings, namely needles,rollers and balls are almost exclusively produced by this class of production processes. Analysis of centreless grinding of balls, in particular a mathematical representation of the dynamics of the process in conjunction with the modelling of the surface profile and its modification thereof appeared to be virgin, unexplored territory which was one of the major incentives behind the current work. As the contents of the work will go on to clarify, the dynamics of balls during the centreless grinding process has its own complexities and peculiarities which necessitates the use of a method that has the virtues of ease of dynamic modelling, modularity of approach and the capacity to integrate multiple energy or energy like quantity within a single framework. The use of bondgraphs stems from the need to satisfy these requirements.

Pertinent features of the process of centreless grinding of balls have been identified with the aid of the bondgraph model developed, Simulation studies have underlined the inherent chaotic nature of motion of the ball during the process. Parametric studies have been carried out to extract the optimal operating conditions, some of which have been confirmed by a collaborating industrial organisation. In addition, simulation studies have revealed that the quality of finish during the grinding process is dependent on the orientation in which the ball enters the grinder. This lends a stochastic colour to the

process. Methods have been suggested by which the overall trend of a large population of balls, entering the grinder in random orientations, may be obtained and predictive studies may be carried out. In addition, the effect of entry orientation on the centreless grinding of cylindrical rollers have also been studied and comparisons with the ball grinding process have been made.