APPLICATIONS OF MULTICRITERIA DECISION MAKING TECHNIQUES FOR JOINT OPTIMIZATION OF DRESSING AND SURFACE GRINDING CONDITIONS

by

ANAND PRAKASH VERMA

A Thesis Submitted
In fulfilment of the requirements for
the degree of

DOCTOR OF PHILOSOPHY

DEPARTMENT OF MECHANICAL ENGINEERING
INDIAN INSTITUTE OF TECHNOLOGY, DELHI

1986

C E R T I F I C A T E

This is to certify that the thesis entitled 'APPLICATIONS OF MULTICRITERIA DECISION MAKING TECHNIQUES FOR JOINT OPTIMIZATION OF DRESSING AND SURFACE GRINDING CONDITIONS'being submitted by Mr. A.P. Verma to the Indian Institute of Technology, Delhi, for the award of the degree of Doctor of Philosophy in Mechanical Engineering is a record of bonafide research work carried out by him. He has worked under our guidance and supervision and has fulfilled the requirements for the submission of this thesis which to our knowledge, has reached the requisite standard.

The results contained in this thesis have not been submitted, in part or in full, to any other University or Institute for the award of any degree or diploma.

30/7/86

N. SINGH
Assistant Professor

U.R.K. RAO
Professor

Department of Mechanical Engineering
INDIAN INSTITUTE OF TECHNOLOGY
New Delhi - 110016.

ACKNOWLEDGEMENTS

I am deeply indebted and profoundly grateful to my esteemed supervisors Dr. U.R.K. Rao, Professor, Department of Mechanical Engineering and Dr. N. Singh, Assistant Professor, Department of Mechanical Engineering for their keen interest, constant encouragement and able guidance. This work would not have been possible without their continuous support and valuable discussions at all stages of this study. Working with them has been a highly rewarding experience. I take this opportunity to offer my most sincere thanks to them.

Special thanks are due to Prof. C. Mohan of Roorkee University whose suggestions and advice have been of immense value.

Thanks are due to Mr. N.C. Sharma of Machine tool laboratory, Mr. I. Mehndiratta of Metrology laboratory and Mr. Kripal Singh of Production Engineering laboratory. The cooperation extended by the staff of Metal cutting laboratory, Production Engineering laboratory, computer centre and other laboratories is gratefully acknowledged.

I am thankful to all the faculty members of the Department for their suggestions and encouragement during the course of this work.

I am thankful to the National Council of Educational Research and Training, Sri Aurobindo Marg, New Delhi for granting me permission to do this research work and also giving me financial assistance and study leave. I am extremely grateful to Dr. P.L. Malhotra, Director, N.C.E.R.T., and to Dr. A.K. Mishra, Head, DVE, N.C.E.R.T., for their kind support and deep understanding.

I am grateful to all my colleagues and friends who have helped me in this work, Thanks are also due to many others who contributed in some way or other to the completion of this thesis.

I am also thankful to my wife, Shalini and my children for their tolerance and understanding.

Anand Prakash Verma

ANAND PRAKASH VERMA

ABSTRACT

A review of the literature dealing with the optimization of the grinding process has been presented.

Data were generated by experimentation based on principle of design of experiments. The data are used to establish relationships between controllable variables viz. work-speed, wheel-speed, depth of cut, dressing depth and dressing lead and the performance criteria namely, surface roughness, residual stress index, hardness, compliance, metal removal rate, specific grinding energy and visual surface quality index. For this purpose, a first and higher order power function models were proposed for each objective function which were transformed into a set of linear equations by logarithmic transformation and the coefficients and exponents were determined by multiple linear regression.

Different policies/priority structures are developed for various practical situations.

Integrated models have been developed for optimization of dressing and grinding variables, independently and jointly, using multicriteria decision making techniques of Goal Programming, Interval Goal Programming and Fuzzy Linear Programming. Statistical analysis is given. Sensitivity studies are carried out. The optimization refers to constrained optimization within the upper and lower limits selected for various controllable variables.

CONTENTS