Human Factors Applications in Teleoperator Design and Operation

Authors Edwin G. Johnsen and William R. Corliss

Publisher Wiley-Interscience

Pages 252

Price $12.95

Reviewer William R. Ferrell

Remote manipulators have long been familiar to nuclear scientists and engineers, enabling them to handle radioactive materials safely through protective barriers of zinc bromide and concrete. Since the 1940's, when engineers at Argonne National Laboratory first set about designing a manipulator well matched to its human operator, the uses of remote manipulation, the kinds of barriers it is designed to surmount, and even the notion itself have expanded far beyond what was originally conceived.

The core idea is for a man to use his skill and judgment to control a dextrous and versatile mechanical extension of himself. This idea has been applied to not only manipulators, which reach across distances, but to "pedipulators," walking machines which can stride over rough terrain, "man-amplifiers," powered exoskeletons for lifting heavy loads, sophisticated prosthetic and orthotic limbs for overcoming physical handicaps, and even remote slave operators that have brain power as well as muscle power of their own. *Teleoperator* is the term, coined by the authors, to include this whole range of devices which extend a man's reach or grasp or stride. The book presents a comprehensive and timely overview of teleoperators with stress on problems of man-machine interaction, design concepts, and specific research or development projects.

Edwin G. Johnsen, the senior author, is chief of the Equipment and Facilities Branch of the AEC/NASA Space Nuclear Propulsion Office. Both as an engineer and as an administrator he has been professionally interested in remote manipulation and has contributed to research and development and to imaginative thinking in the field. Coauthor William R. Corliss is a well known free-lance writer with professional training in physics. Their book is a combination, abridged and somewhat reorganized, of two previous jointly written publications, *Teleoperators and Human Augmentation* and *Teleoperator Controls*, both AEC/NASA Technology Surveys (NASA SP-5047 and SP-5070).

Applications and potential applications of teleoperators, occasionally fanciful, are delineated first. This is followed by a consideration of the subsystems which must be integrated to achieve a working device. The "housekeeping" subsystems such as propulsion, power, and structure are only briefly treated and the greater part of the book is devoted to detailed examinations of the three major subsystems, those for controlling, sensing, and acting.

Control and sensing are the keys to efficient teleoperators. That articulations and terminal devices for manipulators have remained for so long simple linkages and tongs is due less to inability to design marvelously agile arms and hands than to the difficulty of providing the sensing and control necessary to coordinate the multiple degrees of freedom.

The chapters on the control and sensor subsystems outline the special problems encountered in teleoperator design along with a spectrum of approaches to them and descriptions of a variety of controllers and displays. The final chapter on the actuator subsystem is devoted to articulation and powering problems and to the design of terminal devices.

The level of technical treatment throughout is elementary, but the book provides a generally excellent and clearly written introduction to the field for the engineer with a professional interest or even for the general reader. The ample citations and bibliography provide an entry to the technical literature for those who wish to go deeper and they make the work a useful reference for the specialist.

William R. Ferrell, professor of Systems Engineering at The University of Arizona, has taught and done research in remote manipulation, manual control, and human decision making. He studied at Swarthmore College, Swarthmore, Pa., and has a doctorate in mechanical engineering from the Massachusetts Institute of Technology, where he was a member of the faculty.

Nuclear Power

Editor R. V Moore

Publisher Cambridge University Press

Pages 200

Price $10.50

Reviewer G. Victor Beard

The title of the book under review, *Nuclear Power*, is general enough, and at the same time vague enough, that one should not be surprised or disappointed in the contents of a book using such a title.

The description of the book given on the coverleaf, but not in the book proper, probably describes the book as well as it needs to be described. The book is a simple, somewhat dull narrative account of the development of reactor systems designed to generate electrical power throughout the world, with very special emphasis on the English reactors.

Chapter IV, we believe, probably is the only chapter out of context. The rather detailed, and vague (as compared to other books on the development of the neutron chain reaction), account leads one to expect that this concept would be used extensively throughout the rest of the book—an expectation which is not realized.

The reviewer has not attempted to check for accuracy the historical dates, line drawings, or, indeed, any of the data given in Appendix 16. He could see little reason for such a check, as it is his belief anyone having serious need for such information could and would go to the primary sources of information. It is not possible for a single reviewer to know the details, or indeed the general field of nuclear education where it is taught as peripheral information in some other department. It is possible the book may have a useful place in such a setting.

I see little, if any, place for the book in a Nuclear Engineering De-

partment of a typical American university. It is possible that the average, intelligent layman will find the book informative, if not exhilarating.

G. Victor Beard (PhD, physical chemistry, Purdue University) is presently executive director for Associated Western Universities, Inc., a consortia of 35 universities whose primary function, at this time, is to coordinate training and research for faculty and students at the various atomic energy facilities and the national laboratories in the western region of the country.

Prior to this appointment, Dr. Beard spent 11 years with the Atomic Energy Commission at the Idaho Operations Office as director of Health and Safety, as well as having charge of the Organic Reactor Program, and for several years in Washington with the AEC Division of Biology and Medicine and as chief of the Health Protection Branch.

Dr. Beard also served on the teaching staff at The University of Utah for 13 years as professor of chemistry and professor of nuclear engineering.