of Titan and by the large number of index registers available (Titan was the prototype of ATLAS 2 and so incorporates many of the characteristic ATLAS features). In general, the order code is somewhat distended with fixed length instructions of 48 bits: hence a larger number of store fetches would be required than in machines with a variable length and compact order code. Another feature is the Extracode orders, which are system routines performing 'macro' operations in a privileged mode, and extensive use of Extracodes, whose execution cannot be traced, would affect the generality of the address sequences.

While it is not possible to state exactly how far the results based on these address sequences are machine-dependent, it is likely that the trends in paging exhibited here would be applicable for most machines: this claim would be supported by the agreement of some of the results with others produced on greatly different machines (e.g., the AN/FSQ–32 at SDC). They would be subject to the general limitation that in all programs written for non-paged environments no particular effort is made to contain instruction or data areas in fixed length localities, so that programs written consciously for paged machines should show improved characteristics.

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Book Review

Matrix Analysis of Discontinuous Control Systems, by P. V. Bromberg, 1969; 265 pages (*Macdonald and Co. Ltd.* £5.)

This book is concerned with the application of matrix techniques to the solution of problems involving discontinuous control systems. It is intended for graduate and research students in control engineering and related disciplines. The book consists of seven chapters, the first of which introduces the concepts of control systems, illustrating the ideas by examples from the field of aircraft engineering. In the second chapter, the author gives a résumé of the matrix analysis relevant to the analysis of control systems. The succeeding chapter considers the stability of a motion which is defined by difference, as opposed to differential, equations. Several general theorems based on the method of Lyapunov as applied to the discrete system are given and interpreted in terms of the eigenvalues of certain matrices. In the fourth chapter, it is shown how the results of the third chapter, together with the techniques of chapter two, can be applied to determining the behaviour of discontinuous control systems. Again, several examples in the field of aircraft engineering are included. Chapters five and six continue the application of the earlier theory to relay-operated control systems, and to relay systems subject to external disturbances. The final chapter introduces an extension of the theory to a more general class of problem. The mathematics in this book is relatively easy to follow and the reader is left with no doubt that the book is designed for engineering research workers. The book, a translation from Russian, unfortunately suffers from a great many errors which can only lead to confusion. A common error is the omission of the "dot" to denote differentiation. More seriously, the theorem quoted on page 72 is certainly in error, the word 'stable' unfortunately having replaced the word unstable! Errors of these types make the book annoyingly difficult to follow.

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