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OCT 81 H A ANTOSIEWICZ, W A HARRIS DAAG29-77-G-0005
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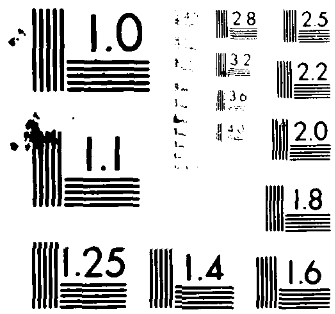

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Ordinary differential equations. Dynamical Systems. Skew-product flows. Singular perturbations. Asymptotic integration. Difference equations.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Research was carried out in several broad areas: existence theory for generalized differential equations and general linear boundary value problems for non linear differential equations; singular perturbation problems and the theory of asymptotic integration; and dynamical systems and skew-product flows.

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FINAL REPORT

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R. J. SACKER

22 OCTOBER 1981

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DEPARTMENT OF MATHEMATICS
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H.A.Antosiewicz

HAA has carried out an extensive research program in the area of generalized linear boundary value problems for nonlinear ordinary differential equations. Using the framework of nonlinear functional analysis, he developed a very flexible unified approach for studying such diverse problems as the existence of solutions with preassigned aymptotic behavior and the existence of periodic solutions under conditions which do not necessarily imply the classical smallness assumptions. He also studied some numerical aspects related to the so-called alternative problems, employing Newton-type iterations in contrast to the usual method of successive approximations.

H. A. Antosiewicz and A. Cellina, "Continuous selections and differential relations", J. Differential Equations 19(1975), 386-398.

H.A. Antosiewicz and A. Cellina, "Continuous extensions: Their construction and their application in the theory of differential equations", pp. 1-8 in International Conference on Differential Equations, Academic Press, 1975.

H.A. Antosiewicz and A. Cellina, "Continuous extensions of multifunctions", Ann. Polon. Math. 34, 107-111 (1977).

H.A. Antosiewicz, "Fixed point theorems and ordinary differential equations", pp. 169-200 in Studies in Ordinary Differential Equations, vol. 14, 1977.

H.A. Antosiewicz, "Same remarks on the existence of periodic solutions", Melanges, Brussels (1978), 7-18.

H.A. Antosiewicz, "A new view on constrained problems", Nonlinear Systems and Applications, (1977), 15-20.

H.A. Antosiewicz, "On stability theory", (In preparation).

W.A. Harris, Jr.

W.A. Harris, Jr. has carried out an extensive research program in singular perturbation theory; behavior of solutions and classification of linear and nonlinear differential and difference equations near singular points; and asymptotic integration.

Singular Perturbation; the method of differential inequalities has been extended and utilized to study some model problems which exhibit many physically recognized phenomena. [See e.g. (1)]

Differential Equations; the summability of formal solutions at irregualr singular points has been studied and the existence of appropriate classes has been established for which the coefficient, and solutions are in the same class . [See e.g. (2)]

Difference Equations; some progress was made in determination of formal and regular invariants similar to differential equations. The sumability of formal solutions in particular classes was established. [See e.g. (3)]

Asymptotic Integration; a unified approach to asymptotic integration has been established which includes (almost) all of the known results and established relationships among the various types of theorems, including asymptotic integration of the adiabatic oscillator. [See e.g. (4)]

1. W.A. Harris, Jr., "Applications of the method of differential inequalities in singular perturbation problems", Proceedings 2nd Scheveningen Conference on Differential Equations, North Holland Pub. Co. 1975, 111-116.

2. W.A. Harris, Jr., "Logarithmic solutions of linear differential equations with a singularity of the first kind Applicable Analysis, 8(1978), 171-174.

3. B.L.J. Braaksma and W.A. Harris, Jr., "Laplace integrals and factorial series in singular functional differential equations", Applicable Analysis, 8(1978).

4. D.A. Lutz and W.A. Harris, Jr., "A unified theory of asymptotic integration", J. Math. Anal. Appl. 57(1977), 571-586.

Robert Sacker

R. Sacker has been engaged in extending his previous results concerning the Splitting Index for Linear Differential Systems of Ordinary Differential Equations to the infinite dimensional case. Basically, the finite dimensional case [1] covers the operator

$$(Lx)(t) = x'(t) - A(t)\,x(t)$$

and gives conditions under which L is a Fredholm operator with index

$$i(L) = -S(A)$$

where S(A) is the Splitting Index of A. The latter quantity is determined by the asymptotic behavior of A at $\pm\infty$ and is readily computable in the case that A is asymptotically constant. The result depends heavily on the recently developed theory of Invariant Splittings due to Sacker and Sell [3] and follow up results of Sacker [2].

To extend the Splitting Index Theorem to the infinite dimensional case one must first generalize the theory of Invariant Splitting to that case. This program has been begun by Sacker and Sell. At present the restrictions imposed to obtain the generalization admit a wide class of operators including retarded functional differential equations and parabolic partial differential equations. Generalizations of most of the critical theorems in [3] have already been obtained.

1. R.J. Sacker, The Splitting Index for Linear Differential Systems, J. Differential Equations 33(1979), 368–405.

2. R.J. Sacker, Part IV of [3], J. Differential Equation 27(1978) 106–137.

3. R.J. Sacker and G.R. Sell, Existence of Dichotomies and Invariant Splittings for Linear Differential Systems, Part I (15) (1974) 429–458, Part II (22) (1976) 478–496.