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September 22, 1988

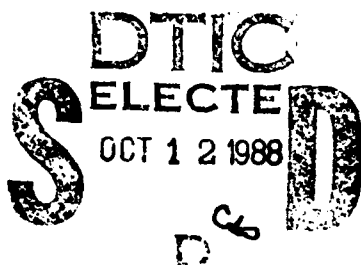
Office of Naval Research
800 North Quincy Street, Code 1111 MA
Arlington, VA 22217-5000

Dear Sirs:

Attached please find my final progress report on ONR Grant:

N000014-85-K-0070
1/1/85 - 12/31/87
J. William Helton, P.I.
Regents of the University of California
University of California, San Diego
Grant titled: Frequency Domain Design of Robust Controllers

AD-A200 746



Sincerely,

J. William Helton
J. William Helton
Principal Investigator

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ONR Final Report
N00014-85-K-0070

Attached is a list of papers which were published between 1985 and 1987 during the term of the above referenced grant. Work focused on several areas:

1. Extending a body of classical function theory and operator theory results to non-linear operators. This ultimately might provide a theory for non-linear H^∞ control.
2. Extending the usual theory of H^∞ approximation to complicated performance objectives. Here I do qualitative and numerical work. Physically this amounts to treating problems of the variety that arise industrially in a direct way. Most work in H^∞ control focuses on much more idealized paradigm cases.
3. Approximation of a given matrix from the subspace of matrices with a given sparsity structure.

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PUBLICATIONS OF J. W. HELTON
1985-1987

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| (1) | J. W. Helton and M. Tabor: "On the classical support of quantum mechanical wave functions," <i>Physica D</i> , 18 (1985), 27-43. | RESEARCH
ARTICLE |
| (2) | J. W. Helton and M. Tabor: "On classical, and quantal Kolmogorov entropies," <i>J. Stat. Physics</i> . | RESEARCH
ARTICLE |
| (3) | J. W. Helton and L. Rodman: "Signature preserving linear maps of Hermitian matrices," <i>Linear and Multilinear Alg.</i> , 17 (1985), 29-37. | RESEARCH
ARTICLE |
| (4) | J. W. Helton and E. A. Jonckheere: "Power Spectrum reduction by optimal Hankel norm approximation of the phase of the outer spectral factor," <i>IEEE Trans. Auto. Cont.</i> , AC-30 (December 1985), 1192-1201. | RESEARCH
ARTICLE |
| (5) | J. W. Helton: "Worst case analysis in the frequency domain: an H^∞ approach to control," <i>IEEE Trans. Auto. Cont.</i> , AC-30 (December 1985), 1154-1170. | RESEARCH
ARTICLE |
| (6) | J. A. Ball and J. W. Helton: "Beurling-Lax representations using classical Lie groups with many applications III: groups preserving forms," <i>Amer. J. Math</i> , 108 (1986), 95-174. | RESEARCH
ARTICLE |
| (7) | J. A. Ball and J. W. Helton: "Interpolation problems of Pick-Nevanlinna and Lowener types for meromorphic matrix functions: parametrization of the set of all solutions," <i>Integral Equations and Operator Theory</i> , 9 (1986), 155-203. | RESEARCH
ARTICLE |
| (8) | J. W. Helton: "Optimization over spaces of analytic functions and the Corona problem," <i>J. Operator Theory</i> , 15, (1986), 359-375. | RESEARCH
ARTICLE |
| (9) | J. W. Helton and R. Howe: "A bang-bang principle for the frequency domain," <i>J. Approx. Theory</i> , 47 (1986), 101-121. | RESEARCH
ARTICLE |
| (10) | J. W. Helton, D. F. Schwartz and S. E. Warschawski: "Local optima in H^∞ produce a constant objective function," <i>J. Complex Analysis</i> , 15 (1986), 359-375. | RESEARCH
ARTICLE |

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|------|--|---------------------|
| (11) | J. A. Ball and J. W. Helton: "Beurling-Lax representations using classical Lie groups with many applications IV: $GL(n,r)$, $U^*(2n)$, $SL(n,\mathbb{C})$, and a solvable group," <i>J. Functional Analysis</i> , 69 (1986), 178-206. | RESEARCH
ARTICLE |
| (12) | C. I. Byrnes and J. W. Helton: "Cascade equivalence of linear systems," <i>Int. J. Control</i> , 44 (1986), 1507-1521. | RESEARCH
ARTICLE |
| (13) | J. Bence, J. W. Helton and D. E. Marshall: "Optimization over H^∞ ," <i>Proc. of Conference on Decision and Control</i> , Athens, Greece, December 1986. | RESEARCH
ARTICLE |
| (14) | M. S. Verma, J. W. Helton, and E. A. Jonckheere: "Robust stabilization of a family of plants with varying number of right half plane poles," preprint. | RESEARCH
ARTICLE |
| (15) | J. W. Helton: Operator theory, analytic functions, matrices and electrical engineering, CBMS Regional Conference Lecture Notes, held at Lincoln, Nebraska, August 1985. Regional Conference Series in Mathematics, No. 68, 1987. | BOOK |
| (16) | J. A. Ball, C. Foias, J. W. Helton, and A. Tannenbaum: "On a local nonlinear commutant lifting theorem," <i>Indiana Journal of Mathematics</i> , 36 (Fall 1987), 693-709. | RESEARCH
ARTICLE |
| (17) | J. A. Ball, J. W. Helton and C. H. Sung: "Nonlinear solutions of Nevanlinna-Pick interpolation problems," <i>Michigan Math. J.</i> , 34 (1987), 375-389. | RESEARCH
ARTICLE |
| (18) | J. W. Helton and L. Rodman: "Vandermonde and resultant matrices: an abstract approach," <i>Math Systems Theory</i> , 20 (1987), 169-192. | RESEARCH
ARTICLE |
| (19) | J. A. Ball and J. W. Helton: "Well posedness of nonlinear causal feedback systems," <i>Proc. of Conference on Decision and Control</i> , Los Angeles, December 1987. | RESEARCH
ARTICLE |
| (20) | F. J. Helton, J. W. Helton and J. M. Greene: "On necessary equilibrium conditions for advanced toroidal plasma experiments," <i>Comments on Plasma Physics and Controlled Fusion</i> , Vol XI No. 3 (1987), 119-164. | RESEARCH
ARTICLE |