Bibliography of the Theory and Application of the Phase-Lock Principle

William C. Lindsey
University of Southern California

Robert C. Tausworthe
Jet Propulsion Laboratory

April 1, 1973
Technical Report 32-1581

A Bibliography of the Theory and Application of the Phase-Lock Principle

William C. Lindsey
University of Southern California

Robert C. Tausworthe
Jet Propulsion Laboratory

JET PROPULSION LABORATORY
CALIFORNIA INSTITUTE OF TECHNOLOGY
PASADENA, CALIFORNIA
April 1, 1973
Preface

The work described in this report was sponsored by the National Aeronautics and Space Administration, under Contract NAS 7-100, and by the Department of the Navy, Office of Naval Research, under Contract N00014-67-A-0269-0022. The National Aeronautics and Space Administration sponsorship was directed through the Telecommunications Division of the Jet Propulsion Laboratory.
Contents

I. Introduction ................................................. 1

II. Listings by Categories ..................................... 2
    A. Books and Monograms .................................. 2
    B. Basic Theory ......................................... 2
    C. Nonlinear Theory ..................................... 6
    D. Acquisition .......................................... 9
    E. Stability ............................................. 12
    F. Threshold ............................................ 14
    G. Demodulator and Discriminator ....................... 16
    H. Performance .......................................... 21
    I. Tracking ............................................. 23
    J. Phase-Locked Receivers ...................... 25
    K. AGC, AFC, and APC Systems ....................... 27
    L. Synchronization ..................................... 30
    M. Operation in Presence of Noise or Interference 32
    N. Oscillator and Frequency Multipliers ............ 35
    O. Cycle Slipping ...................................... 37
    P. Applications ........................................ 38
    Q. Digital Phase-Locked Loops ....................... 41
    R. Miscellaneous ........................................ 44

III. Alphabetic Listing by Authors ......................... 48
Abstract

Since much has been recorded on the phase-locked loop, a literature search was conducted in an effort to collect and compile as many references on the subject as possible. Although not all inclusive, this report presents a comprehensive listing of approximately 800 references covering the past two decades of work reported throughout the world. The compilation is given in two parts: first by categories, and then alphabetically by authors.
I. Introduction

As the reader may be made aware by the mere weight of this report, the world has had much to say about the phase-locked loop over the past two decades. Several years ago, the authors decided to compile as many references on this subject as possible and list them both categorically and alphabetically into one report. The project sounded easy enough. A computer search of the literature generated a six-inch-thick printout of references that had been keyed to such words as "phase lock," "tracking systems," etc. The task remained, however, to first weed out those which did not appear to be appropriate, and then incorporate those with references which we had accumulated over the years, if not already included in the list.

But the more we stirred around in it, the more we found and the bigger the job got. Some references were missing page numbers, journal references, and were otherwise incomplete; others contained errors in the title, journal reference, date, etc. We have attempted to check as many sources as possible, but we know that we still do not have a complete set of references, that in the ones given here errors yet remain, and that some are still inadequate for the reader to locate the cited work.

Readers who detect omitted references or errors in the ones given or who can supply missing information in these references are requested to contact the authors so that the supplemental information can be incorporated into future updates of this report.

A Bibliography of the Theory and Application of the Phase-Lock Principle
II. Listings by Categories

A. Books and Monograms


B. Basic Theory


Phase-Locked Loop Study, Phase I (June 15, 1961) and Phase II (Dec. 15, 1961) of Project 2-520-1202, Motorola, Inc., Military Electronics Division, Scottsdale, Ariz.


C. Nonlinear Theory


Chalkley, H. B., False Lock in Sampled-Data Phase Lock Loops, University Microfilms, Virginia Polytechnic Institute, Blacksburg.


Clelland, L. L., Improvement of Phase-Locked Loops by the Introduction of Nonlinearities, University Microfilms, Purdue University, Lafayette, Ind.


Hussein, A. W., Phase-Error Statistics and a Second-Order Phase-Locked Loop and Design of an Optimum Decision Unit for Space Communications, University Microfilms, Virginia Polytechnic Institute, Blacksburg.

Iceland, L., and Leon, J. B., Improvement of Phase-Locked Loops by the Introduction of Nonlinearities, Purdue University, Lafayette, Ind., 1968.


Lindauer, C. M., Nonlinear Behavior/Analysis and Simulation of Several Second-Order Random-Modulated Phase-Locked Loops, University Microfilms, Virginia Polytechnic Institute, Blacksburg.


Pearce, J. L. R., Optimum Reception of Digital FM Signals, Queens University, Kingston, Ontario.


Thomas, E. F., Investigation and Analog Simulation of the Type Two and Type Three Phase-Lock Loop, AD-295096, Air Force Institute of Technology, Wright-Patterson AFB, Ohio, Dec. 1962.


D. Acquisition


E. Stability


F. Threshold


Urhan, J. J., *Threshold Study of Phase Lock Loop Systems*, University Microfilms, Purdue University, Lafayette, Ind.


**G. Demodulator and Discriminator**


Olsen, D. P., Equivalence of PLL Systems and a Discriminator Followed by a Nonlinear Feedback Filter, Purdue University, Lafayette, Ind., June 1967.


**H. Performance**


I. Tracking


Riedel, E. G., Jr., *The Effect of Frequency Tracking, the Use of a Phase Lock Loop, and Predicted Tracking on Receiver Sensitivity*, AD-286920, Air Force Institute of Technology, Wright-Patterson AFB, Ohio, Aug. 1962.


J. Phase-Locked Receivers


**K. AGC, AFC, and APC Systems**


L. Synchronization


M. Operation in Presence of Noise or Interference


N. Oscillator and Frequency Multipliers


Sakaroff, S., “Frequency-Controlled Oscillators,” Communications, Vol. 19, No. 50, pp. 7–9, 1939.


**O. Cycle Slipping**


**P. Applications**


Gee, T. H., An Analytical and Experimental Investigation of a Frequency-Shift-Keyed Signal Generated by a Phase-Locked-Loop with Application to Narrow-band FSK, University Microfilms, Virginia Polytechnic Institute, Blacksburg, Va.


Athens, Greece, p. 33, Sept. 1965.

Jennings, R. R., and Miller, D. C., A Low Noise Correlation Frequency Tracker,

Kline, A. J., and Moore, W. C., "Phase-Lock Loops in Space Communications,

Lindsey, W. C., Synchronization Systems in Communication and Control, Chap.

Lindsey, W. C. and Simon, M. K., Telecommunication Systems Engineering,


Meer, S. A., "A Class of Wiener Filters Useful in PLL Applications," Proc. IEEE,


Murphy, J. V., "Frequency Measurement Using the Phase-Controlled Oscillator,

Osatake, T., and Fujii, A., "A Study on FM Reception by Tracking Filters,

Pierce, J. A., "Intercontinental Frequency Comparison by VLF Radio Transmis-

Rajasekaran, P. K., and Srinath, M. D., "Switchless Control Strategies for Mini-

Richman, D., "Color-Carrier Reference Phase Synchronization Accuracy in NTSC

Richter, H., Stevens, R., and Sampson, W. F., Microlock: A Minimum Weight
Instrumentation System for a Satellite, JPL External Publication No. 376, Jet
Propulsion Laboratory, Pasadena, Calif.

Shakhgildian, V. V., and Liakhovkin, A. A., "Filtering of a Monochromatic Signal

Smith, L. J., Use of Phase-Lock Loop Control for Driving Ultrasonic Transducers,

Springett, J. C., "Telemetry and Command Techniques for Planetary Spacecraft,

Stein, J. J., and Weber, C. L., "Cascaded Phase Locked Loops," Proc. NEC 68,


**Q. Digital Phase-Locked Loops**


R. Miscellaneous

Active Notch Filter, AD-438 252, Eng. Experiment Station, Georgia Institute of Technology, Atlanta, Ga., Apr. 1964.


III. Alphabetic Listing by Authors


Active Notch Filter, AD-438 252, Eng. Experiment Station, Georgia Institute of Technology, Atlanta, Ga., Apr. 1964.


Burton, D. J., and Hebbert, R. S., Third Order Phase Locked Loops, Naval Ordnance Laboratory, White Oak, Md., Apr. 1969.


Chalkley, H. B., *False Lock in Sampled-Data Phase Lock Loops*, University Microfilms, Virginia Polytechnic Institute, Blacksburg.


Cleland, L. L., Improvement of Phase-Locked Loops by the Introduction of Nonlinearities, University Microfilms, Purdue University, Lafayette, Ind.


Gee, T. H., An Analytical and Experimental Investigation of a Frequency-Shift-Keyed Signal Generated by a Phase-Locked-Loop with Application to Narrowband FSK, University Microfilms, Virginia Polytechnic Institute, Blacksburg, Va.


Heckert, G. P., Design of Phase-Locked FM Demodulators for Maximum Sensitivity, TR 102, Philco Western Development Laboratories (to be published).


Hussein, A. W., *Phase-Error Statistics and a Second-Order Phase-Locked Loop and Design of an Optimum Decision Unit for Space Communications*, University Microfilms, Virginia Polytechnic Institute, Blacksburg.


Lindauer, C. M., Nonlinear Behavior/Analysis and Simulation of Several Second-Order Random-Modulated Phase-Locked Loops, University Microfilms, Virginia Polytechnic Institute, Blacksburg.


JPL TECHNICAL REPORT 32-1581


*Phase-Locked Loop Study*, Phase I (June 15, 1961) and Phase II (Dec. 15, 1961) of Project 2-520-1202, Motorola, Inc., Military Electronics Division, Scottsdale, Ariz.


Riedel, E. G., Jr., The Effect of Frequency Tracking, the Use of a Phase Lock Loop, and Predicted Tracking on Receiver Sensitivity, AD-286920, Air Force Institute of Technology, Wright-Patterson AFB, Ohio, Aug. 1962.


Sakaroff, S., "Frequency-Controlled Oscillators," *Communications*, Vol. 19, No. 50, pp. 7-9, 1939.


Svoboda, D. E., Phase and Amplitude Control for Arrays with Increased Directivity, AD-461 633, Ohio State University Research Foundation, Columbus, Ohio, Mar. 1965.


Thomas, E. F., Investigation and Analog Simulation of the Type Two and Type Three Phase-Lock Loop, AD-295096, Air Force Institute of Technology, Wright-Patterson AFB, Ohio, Dec. 1962.


Urban, J. J., *Cycle Slipping and FM Signal Distortion for a Class of Phase Lock Loops*, Notre Dame University, Ind.

Urban, J. J., *Threshold Study of Phase Lock Loop Systems*, University Microfilms, Purdue University, Lafayette, Ind.


Victor, W. K., Minimum Bandwidths of Phase Lock Loops Using Crystal-Controlled Oscillators, Jet Propulsion Laboratory, Mar. 15, 1954.


Wynn, W. D., The Optimum Phase Demodulator for Interfering PM Subcarrier Signals, Bellcomm, Inc., Washington, D. C.


Ziemer, R. E., Experimental Comparison of Costas and PLL Demulators in RFI Environments, NASA Goddard Space Flight Center, Greenbelt, Md.