

The Development of the Root-Locus Method: Five Historical Studies

Gregory W. Evans

The root-locus method, introduced by Walter R. Evans in 1948, became one of the most widely used graphical techniques in control-system design. Today it appears in nearly every control engineering textbook and is familiar to generations of engineers. Yet the story of how the method emerged, spread through industry and universities, and became embedded in engineering education is less widely known.

The five papers collected in this series examine the early history of the root-locus method from several complementary perspectives. Together they trace the path by which a new engineering idea moved from classroom insight to professional publication, from industrial practice to university curricula, and eventually into textbooks and engineering tools used around the world.

The first paper, “**The Origins of the Root-Locus Method,**” examines the intellectual roots of Evans’s work. It traces the influences of Washington University, the General Electric Advanced Course, and the ideas of Swiss mathematician Paul Profos that helped shape Evans’s thinking about graphical approaches to control-system analysis.

The second study, “**The Struggle to Publish the Root-Locus Method,**” describes the often-overlooked difficulties Evans faced in bringing his work to the engineering literature. Drawing on correspondence and archival materials, it recounts the extended review process that preceded the publication of his landmark 1950 AIEE paper, *Control System Synthesis by Root Locus Method*.

The third paper, “**The Aerophysics Lab at North American Aviation,**” places Evans’s work within the extraordinary engineering environment created at North American Aviation during the early Cold War. Under the leadership of John R. Moore, the laboratory assembled a remarkable group of young engineers who were developing new guidance and control technologies for long-range missiles and inertial navigation systems.

The fourth paper, “**The Spirule,**” examines the development of a simple mechanical device that helped engineers apply the root-locus method quickly and accurately. Conceived within the engineering culture of the Aerophysics Laboratory, the Spirule became an important teaching and design tool during the formative decades of modern control engineering.

Finally, “**Control-System Dynamics: Walter Evans and the Race to Publish Root-Locus in a Textbook,**” explores Evans’s effort to incorporate the method into one of the first servomechanism textbooks. The paper reveals the editorial debates, pedagogical choices, and competitive pressures that shaped the early presentation of root-locus ideas in engineering education.

Taken together, these studies illustrate how engineering innovations spread through a combination of teaching, collaboration, professional publication, and practical tools. They also highlight the importance of the institutional and historical context in which such ideas develop.

These papers draw upon research conducted for the book *Into Stability: Walter R. Evans and the Story of Root Locus*, which presents the broader historical narrative of Evans's life and the engineering community that helped shape modern control-system design.

Additional historical material, documents, and photographs are available at www.walterrevans.com

References for the Historical Studies in the Series

- 1 Loose Sheet "The Jump in the Advance of Automatic Control Enabled by Evans' Root-locus Method and His Spirule," by Robert H. Cannon Jr., Unpublished paper for *Into Stability*, 2004
- 2 Loose Sheets "The Root-locus Method of Walter Evans," R. H. Cannon Jr., Unpublished paper for *Into Stability*, 2004
- 3 Talk Introduction at the Rufus Oldenburger Medal Ceremony Robert H. Cannon Jr., December 1987
- 4 Article "Tribute to Walter R. Evans," Robert H. Cannon Jr, "Dynamic System Control Newsletter," Summer 2000
- 5 Essay History of Control Systems (ChatGPT)
- 6 Family History "His Truth Is Marching On," Greg Evans, Unpublished, 2015
- 7 Family History "St. Louis Saints," Greg Evans, Unpublished, 2020
- 8 Transcript Washington University Transcript, Walter R. Evans, 1937-1941
- 9 Article "The Empire State at War: World War II," New York State War Council, Kurt Drew Hartzell, Ph.D., 1949
- 10 Obituary Obituary for Gordon Walter (June 25, 1919 – July 22, 2022), Online @ DignityMemorial.com
- 11 Interview Notes Author interview of John Moore at Moore's home in April 2003.
- 12 Loose sheet Undated loose sheet with Robert Doherty Quotation
- 13 Article "New Challenges for Eng'rs," W.R. Evans, *Schenectady Eng'ring Council Bulletin*, Vol.III No 3, Nov 1945
- 14 Loose sheet "Love Life of an Engineer," University of South Dakota, Author and Date unknown
- 15 Article "Adv.Course in Engineering," by A. R. Stevenson Jr., and Alan Howard, General Electric, Dec 28, 1934
- 16 Article "Post Collegiate Engineering Education," K.B. Mc Eachron Jr., General Electric, April 1946

- 17 Article "Reminiscences of the Adv. Engineering Prog," Dr. R. Doherty, Carnegie Inst. of Technology, May 1942
- 18 Journal "Graphical Analysis of Control Systems," Walter R. Evans, *AIEE Transactions* Vol. 7, January 1948
- 19 Article "Legacies Left by Former North American Aviation Experts and Executives," J.R. Moore, unabridged 2002
- 20 Notes Design of Servo Mechanisms – Course Notes, Walter R. Evans, 1948
- 21 Senior Paper Nancy Evans Littrell Senior Paper, California Polytechnic Institute, 1971
- 22 Report Aerophysics Lab Report 787 Control System Synthesis by Root-locus Method, W.R. Evans, March 1949
- 23 Book "Chapter 2: Inertial Navigation at NAA 1945–1954" by W.D. Lyon, 13 Jan 1955, in *Twenty Years of Inertial Navigation at North American Aviation*, J. M. Slater, Senior Scientist, 1966
- 24 Oral History Interview of Mr. J. Lee Atwood by Mr. Robert Collins, NASM Oral History Project, June 20, 1989:
- 25 Oral History Interview of Dr. Robert Burnett by Mr. Robert Collins, NASM Oral History Project, June 19, 1989
- 26 Journal "Aerodynamic Stability and Automatic Control," Wright Brothers Lecture, Dr. William. Bollay, December 16, 1950
- 27 Journal "Control System Synthesis by Root-locus Method," W.R. Evans, *AIEE Transactions*, Vol 9, March 1950
- 28 Book *Automatic Control: Classical Linear Theory*, Edited by George J. Thaler, Benchmark Papers, 1974
- 29 Book *Control-System Dynamics*, Walter R. Evans, McGraw-Hill, New York, 1954
- 30 Article "Bringing Root-locus to the Classroom," Gregory Walter Evans, *Control Systems Magazine*, 2004
- 31 Book *The Navaho Missile Project*, James N Gibson, A Schiffer Military History Book, 1996
- 32 Poetry UCLA Engineering Student Newspaper, Vol. VIII, No. 7, March 19, 1956
- 33 Essay Enduring Legacy of Root-locus (ChatGPT)
- 34 Essay Control Theory Continues to Advance in the Age of Computers (ChatGPT)
- 35 Book *Automatic Feedback Control System Synthesis*, John G. Truxal, McGraw-Hill, 1955