

Biography of Aleksandr Lyapunov

Name and Name Modifications:
Alexander Michailowitsch Ljapunow
Aleksandr Michajlvic Ljapunov
Ljapunoff
Liapunov

Dates of Birth and Death:
(∗) 6 June 1857 in Yarolavl, Russia
(†) 3 November 1918 in Odessa,Russia, today Ukraine

Family Data:
Aleksandr's father was the well-known astronomer Mikhail Vasilyevich Lypunov, head of the Demidovski lyceum. The mother was Sofia Aleksandrovna Shilipova. Aleksandr had two brothers, Sergei, who became composer, and Boris, expert for Slavistics. Because of problems with the university the family retired from academic life and moved to the mother's estate in Simbirsk province in 1864. Two years after her husband's death the mother moved to Nizhny-Novgorod.

At 29 years of his age, Lypunov married his cousin Nataliya.

In 1917, Lyapunov together with his seriously ill wife moved to Odessa; he also became partly blind. The day his wife died of tuberculosis he shot himself, but still lived for some days.

Education:
The father taught his two oldest sons Aleksandr and Sergei (1859-1924) at home with the help of books in the subjects mathematics, astronomy, philosophy, history, ethnography, political economy and literature. After the death of the father, the uncle R.M. Sechenov educated him together with his daughter Nataliya Rafailnova.

From 1870 to 1876 Lyapunov together with his friend Andrei Markov (1856-1922) attended the gymnasium in Nizhny-Novgorod.

Lyapunov and Markov then studied at the University of St. Petersburg physico-mathematics under Pafnuty Cebyshev (1821-1894), and chemistry. In 1880, Lyapunov finished his studies to start with research. In 1884, he

was awarded with the M.A. in applied mathematics with his thesis "About the stability of elliptic forms in the equilibrium of turbulent fluid". In 1892 he obtained his Ph.D. at the University Moscow with the dissertation "A general task about the stability of motion".

Professional Career:
In 1895 Lyapunov became private lecturer (Dozent) for Mechanics at the University Kharkov, and, after having obtained his Ph.D. in 1892, he became Professor. After Chebyshev's death in 1894, he became head of the department of Applied Mathematics in 1901 at the Academy of Sciences in St. Petersburg. Among others he did research on probability theory. In 1899, he developed the Lyapunov methods. From 1899-1902 Lyapunov was president of the mathematical society in Kharkov. In 1900, he was elected as corresponding member of the Russian Academy of Sciences and in October 1901 head of the department applied mathematics as successor of Chebyshev. In 1917 he took a position at the University Odessa.

Important Publications:

- Work edition (in Russian): *Sobranie socinenij*, 9 vols. (Moskau 1954-1969).
- "Sur l'instabilité de l'équilibre dans certains cas où la fonction de forces n'est pas un maximum", *Journal de mathématiques pures et appliquées* 3 (1897) pp. 81-94.
- *Stability of motion* (New York 1963, 1966) (translation from the Russian language).
- "Problème générale de la stabilité du mouvement", *Annales de la Faculté des Sciences de Toulouse* 9 (1907) pp. 203-474, repr. als Monographie: (Princeton 1949, sowie New York 1965; Paris 1988), English: *The general problem of the stability of motion* (New York 1966), also as monograph in the series *International journal of control 55*, no. 3 (London 1992).
- *Systems theory research* (New York 1968).
- *Lyapunov centenary issue* (London 1992).

Scientific Honors:
Lyapunov was corresponding member of the Académie des Sciences in Paris and member of the Academia dei Lincei in Italy.

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• Artur Avila, *Simplicity of Lyapunov spectra: a sufficient criterion* (Rio de Janeiro 2005).
• Andrea Bacciotti, *Lyapunov functions and stability in control theory* (Berlin 2001, 2005).
• Dario Bambusi, *Lyapunov center theorem for some nonlinear pde's: a simple proof* (Milano 1999).
• Luis Barreira, *Lyapunov exponents and smooth ergodic theory* (Providence, RI 2002).
• Luis Barreira, *Nonuniform hyperbolicity: dynamics of systems with nonzero Lyapunov exponents* (Cambridge 2007).
• J.F. Barrett, "Bibliography of A.M. Lyapunov's work", *International Journal of Control* 55 (1992) pp. 785-790.
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• Rolando Cavazos-Cadena, "Adaptive control of average Markov decision chains under the Lyapunov stability condition", *Mathematical methods of operations research* 54 (2001) pp. 63-99.
• Elart von Collani (ed.), *Defining the Science of Stochastics* (Lemgo 2004).
• Hans Crauel, "Uniform Lyapunov exponents are realised by ergodic invariant measures", *Stochastics and dynamics* 1 (2001) pp. 113-126.

• Tobias Damm, *Rational matrix equations in stochastic control* (Berlin 2004).
• Warren E. Dixon, *Ninlinear control of engineering systems: a Lyapunov-based approach* (Boston 2003).
• Ralf Eichhorn, *Simple polynomial chaotic models* (Aachen 2002).
• Fernando Fernández Rodríguez, *Testing chaotic dynamics via Lyapunov exponents* (Madrid 2000).
• Fernando Fernández Rodríguez, "Testing chaotic dynamics via Lyapunov exponents", *Journal of applied econometrics* 7 (2005) pp. 911-930.
• Peter Giesl, *Construction of Global Lyapunov functions using radial basis functions* (Berlin, Heidelberg 2007 [Online]).
• Stefan Michael Grünvogel, *Lyapunov spectrum and control sets* (Augsburg 2000).
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Version: 1.00