

# Lyapunov Stability Theory: Foundations of Orbital Mechanics

Daniel Topa  
daniel.topa@hii.com

*Huntington Ingalls Industries*  
*Mission Technologies*

December 28, 2024

## Contents

<b>1</b>	<b>Introduction</b>	<b>1</b>
1.1	Overview of the Problem . . . . .	1
1.2	Objectives . . . . .	1
1.3	Methodology . . . . .	2
<b>2</b>	<b>Backup</b>	<b>2</b>
2.1	A . . . . .	2
2.2	B . . . . .	2
2.3	C . . . . .	2
	<b>References</b>	<b>2</b>

## 1 Introduction

### 1.1 Overview of the Problem

This subsection provides a detailed description of the problem or challenge being addressed in this document.

### 1.2 Objectives

This subsection outlines the main objectives of the document, including key research goals or development targets.

## 1.3 Methodology

This subsection describes the methodology or approach taken to address the problem and achieve the objectives.

## 2 Backup

### 2.1 A

First subsection.

### 2.2 B

Second subsection.

### 2.3 C

Third subsection.

## References

- [1] Luis Barreira and Claudia Valls. “Stability theory and Lyapunov regularity”. In: *Journal of Differential Equations* 232.2 (2007), pp. 675–701.
- [2] Richard Bellman. “Vector lyapunov functions”. In: *Journal of the Society for Industrial and Applied Mathematics, Series A: Control* 1.1 (1962), pp. 32–34.
- [3] T. A. Burton. “On the Construction of Lyapunov Functions”. In: *SIAM Journal on Applied Mathematics* 17.6 (1969), pp. 1078–1085. ISSN: 00361399. (Visited on 12/22/2024).
- [4] S. G. Deo. “On Vector Lyapunov Functions”. In: *Proceedings of the American Mathematical Society* 29.3 (1971), pp. 575–580. ISSN: 00029939, 10886826. (Visited on 12/22/2024).
- [5] Luca Dieci and Erik S. Van Vleck. “Lyapunov Spectral Intervals: Theory and Computation”. In: *SIAM Journal on Numerical Analysis* 40.2 (2003), pp. 516–542. ISSN: 00361429. (Visited on 12/22/2024).
- [6] Peter Giesl. *Construction of global Lyapunov functions using radial basis functions*. Vol. 1904. 190. Springer, 2007.
- [7] Wolfgang Hahn. *Stability of Motion*. Springer, 1967.
- [8] Imad M. Jaimoukha and Ebrahim M. Kasenally. “Krylov Subspace Methods for Solving Large Lyapunov Equations”. In: *SIAM Journal on Numerical Analysis* 31.1 (1994), pp. 227–251. ISSN: 00361429. (Visited on 12/22/2024).
- [9] V. V. Kozlov. “Lyapunov’s Methods in Stability Theory: Historical Perspectives”. In: *Russian Mathematical Surveys* 47.1 (1992), pp. 85–95.

- [10] V Lakshmikantham. “Vector Lyapunov functions and conditional stability”. In: *Journal of Mathematical Analysis and Applications* 10.2 (1965), pp. 368–377.
- [11] V Lakshmikantham. “On the method of vector Lyapunov functions”. In: (1974).
- [12] Joseph LaSalle and Solomon Lefschetz. *Stability by Liapunov’s Direct Method with Applications*. Academic Press, 1961.
- [13] Aleksandr Mikhailovich Liapunov. *Stability of Motion by AM Liapunov*. Vol. 30. Elsevier, 2000.
- [14] A. M. Lyapunov. *The General Problem of the Stability of Motion*. Originally published in Russian (1892), French translation (1907). Princeton University Press, 1947.
- [15] J. L. Massera. “Erratum: Contributions to Stability Theory”. In: *Annals of Mathematics* 68.1 (July 1958). (1 page), p. 202. DOI: 10.2307/1970049.
- [16] José L Massera. “Contributions to stability theory”. In: *Annals of Mathematics* 64.1 (1956), pp. 182–206.
- [17] Salah-Eldin A. Mohammed and Michael K. R. Scheutzow. “Lyapunov Exponents of Linear Stochastic Functional Differential Equations. Part II. Examples and Case Studies”. In: *The Annals of Probability* 25.3 (1997), pp. 1210–1240. ISSN: 00911798, 2168894X. (Visited on 12/22/2024).
- [18] Chutipphon Pukdeboon. “A review of fundamentals of Lyapunov theory”. In: *J. Appl. Sci* 10.2 (2011), pp. 55–61.
- [19] David A. Ross. “An Elementary Proof of Lyapunov’s Theorem”. In: *The American Mathematical Monthly* 112.7 (2005), pp. 651–653. ISSN: 00029890, 19300972. (Visited on 12/22/2024).
- [20] Shankar Sastry and Shankar Sastry. “Lyapunov stability theory”. In: *Nonlinear systems: analysis, stability, and control* (1999), pp. 182–234.
- [21] D. Shevitz and B. Paden. “Lyapunov stability theory of nonsmooth systems”. In: *Proceedings of 32nd IEEE Conference on Decision and Control*. 1993, 416–421 vol.1. DOI: 10.1109/CDC.1993.325114.
- [22] Daniel Shevitz and Brad Paden. “Lyapunov stability theory of nonsmooth systems”. In: *IEEE Transactions on automatic control* 39.9 (1994), pp. 1910–1914.
- [23] V. I. Smirnov. “A. M. Lyapunov and the Stability of Motion”. In: *Uspekhi Matematicheskikh Nauk* (1958). Discusses historical perspectives on Lyapunov’s work.