

Linear operators acting on the Hilbert space usually do not commute and

$$[\hat{A}, \hat{B}] = \hat{A}\hat{B} - \hat{B}\hat{A} \quad (9)$$

is, in general, different from zero.

We want to summarize and prove some useful relations here.

- a) (4 pts) Show that for operators \hat{A} , \hat{B} , \hat{C} and a complex number α

$$\begin{aligned} [\alpha\hat{A}, \hat{B}] &= \alpha[\hat{A}, \hat{B}], & [\hat{A} + \hat{B}, \hat{C}] &= [\hat{A}, \hat{C}] + [\hat{B}, \hat{C}] \\ [\hat{A}\hat{B}, \hat{C}] &= \hat{A}[\hat{B}, \hat{C}] + [\hat{A}, \hat{C}]\hat{B}. \end{aligned} \quad (10)$$

- b) (6 pts) If \hat{A} commutes with $[\hat{A}, \hat{B}]$, i.e., $[\hat{A}, [\hat{A}, \hat{B}]] = 0$, then $[\hat{A}^2, \hat{B}] = \hat{A}[\hat{A}, \hat{B}] + [\hat{A}, \hat{B}]\hat{A}$ can be simplified to $[\hat{A}^2, \hat{B}] = 2\hat{A}[\hat{A}, \hat{B}]$. Show by induction that for a polynomial $p(\hat{A})$ the following relation holds

$$[p(\hat{A}), \hat{B}] = p'(\hat{A})[\hat{A}, \hat{B}] \quad \text{if } [\hat{A}, [\hat{A}, \hat{B}]] = 0. \quad (11)$$

Here $p'(x) = \frac{dp}{dx}$ is the derivative of $p(x)$.

- c) (6 pts) Considering the polynomial in b) as part of a series in \hat{A} we can also use this commutator relation for differentiable functions $f(\hat{A})$ instead of $p(\hat{A})$ (assuming convergence). Proof that

$$e^{\hat{A}}\hat{B}e^{-\hat{A}} = \hat{B} + [\hat{A}, \hat{B}] \quad \text{if } [\hat{A}, [\hat{A}, \hat{B}]] = 0. \quad (12)$$

Linear Operators In Hilbert Space

Jean Louis Soulé



Linear Operators In Hilbert Space:

Theory of Linear Operators in Hilbert Space Naum Il'ich Akhiezer, Izrail' Markovich Glazman, 1963 **Linear Operators in Hilbert Space** Jean Louis Soulé, 1968 **Linear Operators in Hilbert Spaces** Joachim Weidmann, 2012-12-06 This English edition is almost identical to the German original *Lineare Operatoren in Hilbertriiumen* published by B G Teubner Stuttgart in 1976 A few proofs have been simplified some additional exercises have been included and a small number of new results has been added e g Theorem 11 11 and Theorem 11 23 In addition a great number of minor errors has been corrected Frankfurt January 1980 J Weidmann vii Preface to the German edition The purpose of this book is to give an introduction to the theory of linear operators on Hilbert spaces and then to proceed to the interesting applica tions of differential operators to mathematical physics Besides the usual introductory courses common to both mathematicians and physicists only a fundamental knowledge of complex analysis and of ordinary differential equations is assumed The most important results of Lebesgue integration theory to the extent that they are used in this book are compiled with complete proofs in Appendix A I hope therefore that students from the fourth semester on will be able to read this book without major difficulty However it might also be of some interest and use to the teaching and research mathematician or physicist since among other things it makes easily accessible several new results of the spectral theory of differential operators *Theory of Linear Operators in Hilbert Space* Naum Il'ich Ahiezer, 1993 **Inequalities for the Numerical Radius of Linear Operators in Hilbert Spaces** Silvestru Sever Dragomir, 2013-09-14 Aimed toward researchers postgraduate students and scientists in linear operator theory and mathematical inequalities this self contained monograph focuses on numerical radius inequalities for bounded linear operators on complex Hilbert spaces for the case of one and two operators Students at the graduate level will learn some essentials that may be useful for reference in courses in functional analysis operator theory differential equations and quantum computation to name several Chapter 1 presents fundamental facts about the numerical range and the numerical radius of bounded linear operators in Hilbert spaces Chapter 2 illustrates recent results obtained concerning numerical radius and norm inequalities for one operator on a complex Hilbert space as well as some special vector inequalities in inner product spaces due to Buzano Goldstein Ryff and Clarke as well as some reverse Schwarz inequalities and Gr ss type inequalities obtained by the author Chapter 3 presents recent results regarding the norms and the numerical radii of two bounded linear operators The techniques shown in this chapter are elementary but elegant and may be accessible to undergraduate students with a working knowledge of operator theory A number of vector inequalities in inner product spaces as well as inequalities for means of nonnegative real numbers are also employed in this chapter All the results presented are completely proved and the original references are mentioned **Theory of Linear Operators in Hilbert Space** Naum I. Achiezer, 1981 **Theory of Linear Operators in Hilbert Space** N. I. Akhiezer, 1956 *Theory of Linear Operators in Hilbert Space* Naum Il'ich Akhiezer, 1966 *Invitation to Linear Operators*

Takayuki Furuta,2001-07-26 Most books on linear operators are not easy to follow for students and researchers without an extensive background in mathematics Self contained and using only matrix theory Invitation to Linear Operators From Matricies to Bounded Linear Operators on a Hilbert Space explains in easy to follow steps a variety of interesting recent results on linear operators on a Hilbert space The author first states the important properties of a Hilbert space then sets out the fundamental properties of bounded linear operators on a Hilbert space The final section presents some of the more recent developments in bounded linear operators

Theory of Linear Operators in Hilbert Space N. I. Akhiezer,I. M. Glazman,2013-04-15 This classic textbook by two mathematicians from the USSR s prestigious Kharkov Mathematics Institute introduces linear operators in Hilbert space and presents in detail the geometry of Hilbert space and the spectral theory of unitary and self adjoint operators It is directed to students at graduate and advanced undergraduate levels but because of the exceptional clarity of its theoretical presentation and the inclusion of results obtained by Soviet mathematicians it should prove invaluable for every mathematician and physicist 1961 1963 edition

Kato's Type Inequalities for Bounded Linear Operators in Hilbert Spaces Silvestru Sever Dragomir,2019-05-24 The aim of this book is to present results related to Kato s famous inequality for bounded linear operators on complex Hilbert spaces obtained by the author in a sequence of recent research papers As Linear Operator Theory in Hilbert spaces plays a central role in contemporary mathematics with numerous applications in fields including Partial Differential Equations Approximation Theory Optimization Theory and Numerical Analysis the volume is intended for use by both researchers in various fields and postgraduate students and scientists applying inequalities in their specific areas For the sake of completeness all the results presented are completely proved and the original references where they have been firstly obtained are mentioned

Theory of Linear Operators in Hilbert Space Naum Il'ich Akhiezer,1981 **Basic Operator Theory** Israel Gohberg,Seymour Goldberg,2013-12-01 rii application of linear operators on a Hilbert space We begin with a chapter on the geometry of Hilbert space and then proceed to the spectral theory of compact self adjoint operators operational calculus is next presented as a nat ural outgrowth of the spectral theory The second part of the text concentrates on Banach spaces and linear operators acting on these spaces It includes for example the three basic principles of linear analysis and the Riesz Fredholm theory of compact operators Both parts contain plenty of applications All chapters deal exclusively with linear problems except for the last chapter which is an introduction to the theory of nonlinear operators In addition to the standard topics in functional anal ysis we have presented relatively recent results which appear for example in Chapter VII In general in writ ing this book the authors were strongly influenced by re cent developments in operator theory which affected the choice of topics proofs and exercises One of the main features of this book is the large number of new exercises chosen to expand the reader s com prehension of the material and to train him or her in the use of it In the beginning portion of the book we offer a large selection of computational exercises later the proportion of exercises dealing with theoretical questions

increases We have however omitted exercises after Chapters V VII and XII due to the specialized nature of the subject matter

Introduction to the Theory of Linear Nonselfadjoint Operators Israel Gohberg, Mark Grigor'evich Kreĭn, 1978

Linear Operators in Hilbert Space Morton Raymond Dubman, 1959

A Chapter in the Theory of Linear Operators in Hilbert Space Kurt Otto Friedrichs, 1951

Theory of Linear Operators in Hilbert Space Naum I. Achiezer, I. M. Glazman, 1963

Operators on Hilbert Space V. S. Sunder, 2016-08-05 The primarily objective of the book is to serve as a primer on the theory of bounded linear operators on separable Hilbert space The book presents the spectral theorem as a statement on the existence of a unique continuous and measurable functional calculus It discusses a proof without digressing into a course on the Gelfand theory of commutative Banach algebras The book also introduces the reader to the basic facts concerning the various von Neumann Schatten ideals the compact operators the trace class operators and all bounded operators

Application of the Theory of Linear Operators in Hilbert Space to Potential Theory E. J. Specht, H. T. Jones, 1957

Triangular and Jordan Representations of Linear Operators M. S. Brodskii, 1971 Determining the invariant subspaces of any given transformation and writing the transformation as an integral in terms of invariant subspaces is a fundamental problem This book presents the foundations of the theory of triangular and Jordan representations of bounded linear operators in Hilbert space and solves the problem in the case of completely continuous transformations The reader is assumed to know the basics of linear operator theory

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