6.003: Signals and Systems

Laplace Transform

September 27, 2011

Lecture 6 Laplace Transform Mit Opencourseware

Francis Dominic Murnaghan

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   Principles of Mathematics in Operations Research Levent Kandiller,2006-12-18 Principles of Mathematics in Operations Research is a comprehensive survey of the mathematical concepts and principles of industrial mathematics Its purpose is to provide students and professionals with an understanding of the fundamental mathematical principles used in Industrial Mathematics OR in modeling problems and application solutions All the concepts presented in each chapter have undergone the learning scrutiny of the author and his students The conceptual relationships within the chapter material have been developed in the classroom experience working with the students level of understanding The illustrative material throughout the book i e worked out problems and examples of the mathematical principles was refined for student comprehension as the manuscript developed through its iterations and the chapter exercises are refined from the previous year s exercises In sum the author has carefully developed a pedagogically strong survey textbook of OR and Industrial Mathematics   The Laplace Transformation Francis Dominic Murnaghan,2012-07-01 In Three Volumes Volume 1 The Laplace Transformation Volume 2 The Calculus Of Variations Volume 3 The Unitary And Rotation Groups   **Laplace Transforms** Mohamed F. El-Hewie,2013-04-15 This is a revised edition of the chapter on Laplace Transforms which was published few years ago in Part II of My Personal Study Notes in advanced mathematics In this edition I typed the cursive scripts of the personal notes edited the typographic errors but most of all reproduced all the calculations and graphics in a modern style of representation The book is organized into six chapters equally distributed to address 1 The theory of Laplace transformations and inverse transformations of elementary functions supported by solved examples and exercises with given answers 2 Transformation of more complex functions from elementary transformation 3 Practical applications of Laplace transformation to equations of motion of material bodies and deflection stress and strain of elastic beams 4 Solving equations of state of motion of bodies under inertial and gravitational forces 5 Solving heat flow equations through various geometrical bodies and 6 Solving partial differential equations by the operational algebraic properties of transforming and inverse transforming of partial differential equations During the editing process I added plenty of comments of the underlying meaning of the arcane equations such that the reader could discern the practical weight of each mathematical formula In a way I attempted to convey a personal sense and feeling on the significance and philosophy of devising a mathematical equation that transcends into real life emulation The reader will find this edition dense with graphic illustrations that should spare the reader the trouble of searching other references in order to infer any missing steps In my view detailed graphic illustrations could soothe the harshness of arcane mathematical jargon as well as expose the merits of the assumption contemplated in the formulation In lieu of offering a dense textbook on Laplace Transforms I opted to stick to my personal notes that give the memorable zest of a subject that could easily remembered when not frequently used Brief Outline of Contents CHAPTER 1 THE LAPLACE TRANSFORMATION AND INVERSE TRANSFORMATION 1 1 Integral transforms 1 2

Some elementary Laplace transforms 1 3 The Laplace transformation of the sum of two functions 1 4 Sectionally or piecewise continuous functions 1 5 Functions of exponential order 1 7 Null functions 1 8 Inverse Laplace transforms 1 10 Laplace transforms of derivatives 1 11 Laplace transforms of integrals 1 12 The first shift theorem of multiplying the object function by eat 1 15 Determination of the inverse Laplace transforms by the aid of partial fractions 1 16 Laplace s solution of linear differential equations with constant coefficients CHAPTER 2 GENERAL THEOREMS ON THE LAPLACE TRANSFORMATION 2 1 The unit step function 2 2 The second translation or shifting property 2 4 The unit impulse function 2 5 The unit doublet 2 7 Initial value theorem 2 8 Final value theorem 2 9 Differentiation of transform 2 11 Integration of transforms 2 12 Transforms of periodic functions 2 13 The product theorem Convolution 2 15 Power series method for the determination of transforms and inverse transforms 2 16 The error function or probability integral 2 22 The inversion integral CHAPTER 3 ELECTRICAL APPLICATIONS OF THE LAPLACE TRANSFORMATION CHAPTER 4 DYNAMICAL APPLICATIONS OF LAPLACE TRANSFORMS CHAPTER 5 STRUCTURAL APPLICATIONS 5 1 Deflection of beams CHAPTER 6 USING LAPLACE TRANSFORMATION IN SOLVING LINEAR PARTIAL DIFFERENTIAL EQUATIONS 6 1 Transverse vibrations of a stretched string under gravity 6 2 Longitudinal vibrations of bars 6 3 Partial differential equations of transmission lines 6 4 Conduction of heat 6 5 Exercise on using Laplace Transformation in solving Linear Partial Differential Equations **Laplace Transforms Essentials** Morteza Shafii-Mousavi,2013-01-01 REA s Essentials provide quick and easy access to critical information in a variety of different fields ranging from the most basic to the most advanced As its name implies these concise comprehensive study guides summarize the essentials of the field covered Essentials are helpful when preparing for exams doing homework and will remain a lasting reference source for students teachers and professionals Laplace Transforms includes the Laplace transform the inverse Laplace transform special functions and properties applications to ordinary linear differential equations Fourier transforms applications to integral and difference equations applications to boundary value problems and tables **Introduction to the Laplace Transform** Peter K.F. Kuhfittig,2013-06-29 The purpose of this book is to give an introduction to the Laplace transform on the undergraduate level The material is drawn from notes for a course taught by the author at the Milwaukee School of Engineering Based on classroom experience an attempt has been made to 1 keep the proofs short 2 introduce applications as soon as possible 3 concentrate on problems that are difficult to handle by the older classical methods and 4 emphasize periodic phenomena To make it possible to offer the course early in the curriculum after differential equations no knowledge of complex variable theory is assumed However since a thorough study of Laplace transforms requires at least the rudiments of this theory Chapter 3 includes a brief sketch of complex variables with many of the details presented in Appendix A This plan permits an introduction of the complex inversion formula followed by additional applications The author has found that a course taught three hours a week for a quarter can be based on the material in Chapters 1 2 and 5 and the first three sections of Chapter 7 If additional time is

available e g four quarter hours or three semester hours the whole book can be covered easily The author is indebted to the students at the Milwaukee School of Engineering for their many helpful comments and criticisms **Engineering Applications of the Laplace Transform** Y.H. Gangadharaiah,N. Sandeep,2021-08-25 This book is devoted to one of the most critical areas of applied mathematics namely the Laplace transform technique for linear time invariance systems arising from the fields of electrical and mechanical engineering It focuses on introducing Laplace transformation and its operating properties finding inverse Laplace transformation through different methods and describing transfer function applications for mechanical and electrical networks to develop input and output relationships It also discusses solutions of initial value problems the state variables approach and the solution of boundary value problems connected with partial differential equations **Applied Laplace Transforms and z-Transforms for Scientists and Engineers** Urs Graf,2012-12-06 The theory of Laplace transformation is an important part of the mathematical background required for engineers physicists and mathematicians Laplace transformation methods provide easy and effective techniques for solving many problems arising in various fields of science and engineering especially for solving differential equations What the Laplace transformation does in the field of differential equations the z transformation achieves for difference equations The two theories are parallel and have many analogies Laplace and z transformations are also referred to as operational calculus but this notion is also used in a more restricted sense to denote the operational calculus of Mikusinski This book does not use the operational calculus of Mikusinski whose approach is based on abstract algebra and is not readily accessible to engineers and scientists The symbolic computation capability of Mathematica can now be used in favor of the Laplace and z transformations The firstversion of the Mathematica Package LaplaceAndzTransforrns developed by the author appeared ten years ago The Package computes not only Laplace and z transforms but also includes many routines from various domains of applications Upon loading the Package about one hundred and fifty new commands are added to the built in commands of Mathematica The code is placed in front of the already built in code of Laplace and z transformations of Mathematica so that built in functions not covered by the Package remain available The Package substantially enhances the Laplace and z transformation facilities of Mathematica The book is mainly designed for readers working in the field of applications **The Laplace Transform** Joel L. Schiff,2014-01-15 *An Introduction to Laplace Transforms and Fourier Series* Phil Dyke,2000-10-27 This introduction to Laplace transforms and Fourier series is aimed at second year students in applied mathematics It is unusual in treating Laplace transforms at a relatively simple level with many examples Mathematics students do not usually meet this material until later in their degree course but applied mathematicians and engineers need an early introduction Suitable as a course text it will also be of interest to physicists and engineers as supplementary material **Laplace Transforms and an Introduction to Distributions** Paul B. Guest,1991 The Laplace Transformation Francis Dominic Murnaghan,1962 **The Laplace Transform** ,1981 *An Introduction to the Laplace Transformation* John Conrad

Jaeger,Gordon Newstead,1969   **Laplace-Transformation** Ameling Walter,1979-01-01 Die Laplace Transformation hat durch die Breite ihrer Anwendungsmoglichkei ten standig im Bereich der Technik an Bedeutung gewonnen Sie ist heute ftir den in der Praxis stehenden Ingenieur Physiker und Mathematiker ein wertvol les Hilfsmittel zur Bewaltigung seiner Aufgaben geworden Mit diesem Buch mochte ich sowohl dem Studierenden an Hoch und Fachhoch schulen als auch dem Ingenieur der Praxis die Theorie und Anwendung der Laplace Transformation auf tibersichtliche Art naherbringen An fast allen Hochschulen ist die Theorie der Laplace Transformation in gewis sem Umfang heute bereits ein feststehender Bestandteil in der Grundlagenaus bildung Sowohl fUr den Elektro Ingenieur und hier insbesondere fUr den Elek tronik Ingenieur als auch flir den Regelungstechniker ist der vertraute Umgang mit der Laplace Transformation ein notwendiges Rtistzeug zur Bewaitigung sei ner Probleme Bei der Auswahl und Anordnung des Stoffes bin ich davon ausgegangen daB die Laplace Transformation flir den Ingenieur nicht nur eine klare und exakte Theorie zur Behandlung von Differentialgleichungen oder technischen Schalt vorgangen sein soli sie soli ihn auBerdem in die Lage versetzen Probleme der Praxis erfolgreich zu bearbeiten Aus didaktischen Grunden habe ich es vorgezogen nicht direkt mit der Vorstel lung und Definition des Laplace Integrals selbst zu beginnen sondern eine Hin leitung zu vermitteln und eine Einflihrung in das Gebiet zu geben Ich bin davon ausgegangen daB durch eine kurze Behandlung nichtsinusformiger periodischer und nichtperiodischer Vorgange mit Hilfe der Fourier Reihe bzw dem Fourier Integral ein besseres Verstandnis flir das Wesen der Integraitransformation ermoglicht wird und der Ubergang zur Laplace Transformation dem Leser bes ser nahegebracht wird   *The Laplace Transform* Earl David Rainville,1971   **Laplace-Transformation** Walter Ameling,1984-01-01 Die Laplace Transformation hat durch die Breite ihrer Anwendungsmoglichkei ten stiindig im Bereich der Technik an Bedeutung gewonnen Sie ist heute ftir den in der Praxis stehenden Ingenieur Physiker und Mathematiker ein wertvol les Hilfsmittel zur BewaItigung seiner Aufgaben geworden Mit diesem Buch mochte ich sowohl dem Studierenden an Hoch und Fachhoch schulen als auch dem Ingenieur der Praxis die Theorie und Anwendung der Laplace Transformation auf tibersichtliche Art naherbringen An fast allen Hochschulen ist die Theorie der Laplace Transformation in gewis sem Umfang heute bereits ein feststehender Bestandteil in der Grundlagenaus bildung Sowohl fiir den Elektro Ingenieur und hier insbesondere fiir den Elek tronik Ingenieur als auch flir den Regelungstechniker ist der vertraute Umgang mit der Laplace Transformation ein notwendiges Rtistzeug zur Bewaltigung sei ner Probleme Bei der Auswahl und Anordnung des Stoffes bin ich davon ausgegangen daB die Laplace Transformation flir den Ingenieur nicht nur eine klare und exakte Theorie zur Behandlung von Differentialgleichungen oder technischen SchaIt vorgangen sein soli sie soli ihn auBerdem in die Lage versetzen Probleme der Praxis erfolgreich zu bearbeiten Aus didaktischen Grunden habe ich es vorgezogen nicht direkt mit der Vorstel lung und Definition des Laplace Integrals selbst zu beginnen sondern eine Hin leitung zu vermitteln und eine Einflihrung in das Gebiet zu geben Ich bin davon ausgegangen daB durch eine kurze Behandlung nichtsinusfOrmiger periodischer und

nichtperiodischer Vorgange mit Hilfe der Fourier Reihe bzw dem Fourier Integral ein besseres Verstandnis flir das Wesen der Integraltransformation ermogIicht wird und der Obergang zur Laplace Transformation dem Leser bes ser nahegebracht wird   *An Introduction to Laplace Transforms and Fourier Series* Phil Dyke,2014-04-30   **Numerical Methods for Laplace Transform Inversion** Alan M. Cohen,2010-11-23 This book gives background material on the theory of Laplace transforms together with a fairly comprehensive list of methods that are available at the current time Computer programs are included for those methods that perform consistently well on a wide range of Laplace transforms Operational methods have been used for over a century to solve problems such as ordinary and partial differential equations   Tables of Laplace Transforms Fritz Oberhettinger,Larry Badii,1973 This material represents a collection of integrals of the Laplace and inverse Laplace Transform type The usef ness of this kind of information as a tool in various branches of Mathematics is firmly established Previous publications include the contributions by A Erdelyi and Roberts and Kaufmann see References Special consideration is given to results involving higher functions as integrand and it is believed that a substantial amount of them is presented here for the first time Greek letters denote complex parameters within the given range of validity Latin letters denote unless otherwise stated real positive parameters and a possible extension to complex values by analytic continuation will often pose no serious problem The authors are indebted to Mrs Jolan Eross for her tireless effort and patience while typing this manu script Oregon State University Corvallis Oregon Eastern Michigan University Ypsilanti Michigan The Authors Contents Part I Laplace Transforms In troduction 1 1 1 General Formulas 3 1 2 Algebraic Functions 12 1 3 Powers of Arbitrary Order 21 1 4 Sectionally Rational and Rows of Delta Functions 28 1 5 Exponential Functions 37 1 6 Logarithmic Functions 48 1 7 Trigonometric Functions 54 1 8 Inverse Trigonometric Functions 81 1 9 Hyperbolic Functions 84 1 10 Inverse Hyperbolic Functions 99 1 11 Orthogonal Polynomials 103 1 12 Legendre Functions 113 1 13 Bessel Functions of Order Zero and Unity 119 1 14 Bessel Functions 134 1 15 Modified Bessel Functions   *Laplace Transforms* J. Williams,1973

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