Elements Of Dynamic Optimization

Elements Of Dynamic Optimization Elements of Dynamic Optimization 1 This document provides an overview of the fundamental elements of dynamic optimization a powerful tool used in various fields like engineering economics and finance Dynamic optimization deals with finding optimal control strategies for systems evolving over time It differs from static optimization which focuses on finding the best solution at a single point in time by considering the impact of decisions on future states II Basic Concepts Dynamic System A system whose state evolves over time This evolution is described by a set of differential equations often called the system dynamics Control Variables Variables that can be manipulated to influence the behavior of the dynamic system State Variables Variables that describe the state of the dynamic system at any given time Objective Function A function that quantifies the performance of the system over the time horizon It is typically expressed as an integral over time of a function of state and control variables Constraints Conditions that limit the values of control and state variables They can be equality or inequality constraints Optimal Control Problem The problem of finding the control strategy that maximizes or minimizes the objective function subject to the system dynamics and constraints III The Dynamic Programming Approach Dynamic programming DP is a powerful technique for solving dynamic optimization problems It relies on the principle of optimality which states that an optimal policy has the property that whatever the initial state and initial decision are the remaining decisions must constitute an optimal policy with regard to the state resulting from the first decision Bellmans Equation DP utilizes the Bellmans equation which recursively relates the value function at a given time to the value function at the next time step It essentially breaks down 2 the optimization problem into a sequence of smaller simpler subproblems Value Function The value function represents the optimal value of the objective function for a given state at a given time It provides a crucial element for decisionmaking Backward Iteration DP typically involves working

BACKWARD IN TIME STARTING FROM THE TERMINAL TIME AND PROGRESSIVELY COMPUTING THE VALUE FUNCTION AT EACH TIME STEP This PROCESS HELPS TO IDENTIFY THE OPTIMAL CONTROL STRATEGY AT EACH STAGE IV Common Dynamic Optimization Problems Optimal Control of Linear Systems These PROBLEMS INVOLVE SYSTEMS WHOSE DYNAMICS ARE DESCRIBED BY LINEAR DIFFERENTIAL EQUATIONS They ARE OFTEN SOLVED USING LINEAR QUADRATIC REGULATORS LQR Optimal Control of Nonlinear Systems These PROBLEMS INVOLVE SYSTEMS WITH NONLINEAR DYNAMICS REQUIRING MORE COMPLEX SOLUTION TECHNIQUES SUCH AS NUMERICAL METHODS Stochastic Optimal Control These PROBLEMS CONSIDER SYSTEMS SUBJECT TO RANDOM DISTURBANCES The OPTIMAL CONTROL STRATEGY MUST ACCOUNT FOR THE UNCERTAINTY IN THE SYSTEM DYNAMICS DiscreteTime Optimal Control These PROBLEMS INVOLVE SYSTEMS WHERE THE STATE AND CONTROL VARIABLES ARE DEFINED AT DISCRETE POINTS IN TIME They ARE OFTEN SOLVED USING DYNAMIC PROGRAMMING ALGORITHMS V Solution Techniques Analytical Methods For SIMPLE PROBLEMS WITH SPECIFIC STRUCTURES ANALYTICAL METHODS LIKE Pontryagins Maximum Principle PMP CAN BE USED TO DERIVE THE OPTIMAL CONTROL STRATEGY Numerical Methods For COMPLEX PROBLEMS WITH NONLINEAR DYNAMICS NUMERICAL METHODS LIKE SHOOTING METHODS COLLOCATION METHODS AND GRADIENTBASED ALGORITHMS ARE TYPICALLY EMPLOYED TO APPROXIMATE THE SOLUTION Software Tools Several SOFTWARE PACKAGES ARE AVAILABLE FOR SOLVING DYNAMIC OPTIMIZATION PROBLEMS INCLUDING MATLAB Python LIBRARIES LIKE SciPy AND SymPy AND SPECIALIZED SOFTWARE LIKE GAMS AND AMPL VI Applications in Different Fields Engineering Design OF OPTIMAL CONTROL SYSTEMS FOR ROBOTS AEROSPACE VEHICLES AND OTHER COMPLEX SYSTEMS 3 Economics Optimal RESOURCE ALLOCATION INVESTMENT DECISIONS AND MACROECONOMIC POLICY ANALYSIS Finance Portfolio OPTIMIZATION RISK MANAGEMENT AND PRICING OF FINANCIAL DERIVATIVES Biology Modelling AND CONTROL OF BIOLOGICAL SYSTEMS SUCH AS POPULATION DYNAMICS AND GENE REGULATION VII Advantages of Dynamic Optimization Comprehensive Optimization It CONSIDERS THE SYSTEMS DYNAMIC BEHAVIOR LEADING TO MORE REALISTIC AND ROBUST SOLUTIONS COMPARED TO STATIC OPTIMIZATION Adaptive Control It ALLOWS FOR ADAPTING CONTROL STRATEGIES BASED ON THE EVOLVING STATE OF THE SYSTEM Optimal Resource Allocation It ENABLES EFFICIENT ALLOCATION OF RESOURCES OVER TIME TO ACHIEVE DESIRED OBJECTIVES VIII Challenges of Dynamic Optimization Computational Complexity Solving DYNAMIC OPTIMIZATION PROBLEMS CAN BE COMPUTATIONALLY DEMANDING ESPECIALLY FOR COMPLEX

systems Model Uncertainty The accuracy of the solution depends on the accuracy of the system model which can be difficult to obtain in practice Data Availability Realtime data may be required to implement optimal control strategies which can pose limitations in certain applications IX Conclusion Dynamic optimization is a powerful tool for optimizing systems evolving over time It provides a framework for finding optimal control strategies considering both the current state and the future evolution of the system By leveraging the principle of optimality and employing various solution techniques dynamic optimization finds wide applications across diverse fields offering solutions to complex problems with timevarying dynamics However its complexity and reliance on accurate models and data availability pose certain challenges that require careful consideration 4

Elements of Dynamic OptimizationPrinciples of Dynamic OptimizationPrinciples of Dynamic OptimizationDynamic OptimizationDynamic Optimization for BeginnersA Method of Dynamic Programming and Its Application to Optimization Problems of Flight MechanicsTwo Economic Applications of Dynamic Optimization TheoryTwo Economic Applications of Dynamic Optimization TheoryApplications Of Dynamic Programming To Agricultural Decision ProblemsDynamic OptimizationDynamic Optimization Technology a Complete GuideDynamic ProgrammingMethods of Dynamic and Nonsmooth OptimizationDynamic Optimization and ControlDynamic EconomicsOptimization Over TimeDynamic Optimization and Mathematical EconomicsDynamic Optimization of Path-Constrained Switched SystemsOn the Nature of Policy Functions of Dynamic Optimization ModelsOptimization of Stainless Steel Melting Practice by Means of Dynamic Programming Alpha C. Chiang Piernicola Bettiol Piernicola Bettiol Piermarco Cannarsa Werner Schulz Reno M. Black Reno Michael Black C. Robert Taylor Arthur Earl Bryson Gerardus Blokdyk Moshe Sniedovich Frank H. Clarke Walerian Kipiniak Gregory C. Chow Peter Whittle Pan-Tai Liu Jun Fu Tapan Mitra Eduardo Macatangay Calanog

Elements of Dynamic Optimization Principles of Dynamic Optimization Principles of Dynamic Optimization Dynamic Optimization Dynamic Optimization for Beginners A Method of Dynamic Programming and Its Application to Optimization Problems of Flight Mechanics Two Economic

APPLICATIONS OF DYNAMIC OPTIMIZATION THEORY TWO ECONOMIC APPLICATIONS OF DYNAMIC OPTIMIZATION THEORY APPLICATIONS OF DYNAMIC PROGRAMMING TO AGRICULTURAL DECISION PROBLEMS DYNAMIC OPTIMIZATION DYNAMIC OPTIMIZATION TECHNOLOGY A COMPLETE GUIDE DYNAMIC PROGRAMMING METHODS OF DYNAMIC AND NONSMOOTH OPTIMIZATION DYNAMIC OPTIMIZATION AND CONTROL DYNAMIC ECONOMICS OPTIMIZATION OVER TIME DYNAMIC OPTIMIZATION AND MATHEMATICAL ECONOMICS DYNAMIC OPTIMIZATION OF PATH-CONSTRAINED SWITCHED SYSTEMS ON THE NATURE OF POLICY FUNCTIONS OF DYNAMIC OPTIMIZATION MODELS OPTIMIZATION OF STAINLESS STEEL MELTING PRACTICE BY MEANS OF DYNAMIC PROGRAMMING *ALPHA C. CHIANG PIERNICOLA BETTIOL PIERNICOLA BETTIOL PIERMARCO CANNARSA WERNER SCHULZ RENO M. BLACK RENO MICHAEL BLACK C. ROBERT TAYLOR ARTHUR EARL BRYSON GERARDUS BLOKDYK MOSHE SNIEDOVICH FRANK H. CLARKE WALERIAN KIPINIAK GREGORY C. CHOW PETER WHITTLE PAN-TAI LIU JUN FU TAPAN MITRA EDUARDO MACATANGAY CALANOG*

DESIGNED TO BE USED WITH CHIANG S FUNDAMENTAL METHODS OF MATHEMATICAL ECONOMICS OR INDEPENDENTLY AT ADVANCED UNDERGRADUATE OR GRADUATE LEVEL THIS TEXT PRESENTS AN IN DEPTH EXPLORATION OF DYNAMIC OPTIMIZATION IN ECONOMICS

THIS MONOGRAPH EXPLORES KEY PRINCIPLES IN THE MODERN THEORY OF DYNAMIC OPTIMIZATION INCORPORATING IMPORTANT ADVANCES IN THE FIELD TO PROVIDE A COMPREHENSIVE MATHEMATICALLY RIGOROUS REFERENCE EMPHASIS IS PLACED ON NONSMOOTH ANALYTIC TECHNIQUES AND AN IN DEPTH TREATMENT OF NECESSARY CONDITIONS MINIMIZER REGULARITY AND GLOBAL OPTIMALITY CONDITIONS RELATED TO THE HAMILTON JACOBI EQUATION IS GIVEN NEW STREAMLINED PROOFS OF FUNDAMENTAL THEOREMS ARE INCORPORATED THROUGHOUT THE TEXT THAT ELIMINATE EARLIER CUMBERSOME REDUCTIONS AND CONSTRUCTIONS THE FIRST CHAPTER OFFERS AN EXTENDED OVERVIEW OF DYNAMIC OPTIMIZATION AND ITS HISTORY THAT DETAILS THE SHORTCOMINGS OF THE ELEMENTARY THEORY AND DEMONSTRATES HOW A DEEPER ANALYSIS AIMS TO OVERCOME THEM ASPECTS OF DYNAMIC PROGRAMMING WELL MATCHED TO ANALYTICAL TECHNIQUES ARE CONSIDERED IN THE FINAL CHAPTER INCLUDING CHARACTERIZATION OF EXTENDED VALUE FUNCTIONS ASSOCIATED WITH PROBLEMS HAVING ENDPOINT AND STATE CONSTRAINTS INVERSE VERIFICATION THEOREMS SENSITIVITY RELATIONSHIPS AND LINKS TO THE MAXIMUM PRINCIPLE THIS TEXT WILL BE A VALUABLE RESOURCE FOR THOSE SEEKING AN UNDERSTANDING OF DYNAMIC OPTIMIZATION THE LUCID EXPOSITION INSIGHTS INTO THE FIELD AND COMPREHENSIVE COVERAGE WILL BENEFIT

POSTGRADUATES RESEARCHERS AND PROFESSIONALS IN SYSTEM SCIENCE CONTROL ENGINEERING OPTIMIZATION AND APPLIED MATHEMATICS

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A COLLECTION OF ARTICLES WHICH PROVIDE EXAMPLES THAT DEMONSTRATE THE APPLICATION OF DYNAMIC PROGRAMMING TO A WIDE VARIETY OF DECISION PROBLEMS IN AGRICULTURE

DYNAMIC OPTIMIZATION TAKES AN APPLIED APPROACH TO ITS SUBJECT OFFERING MANY EXAMPLES AND SOLVED PROBLEMS THAT DRAW FROM AEROSPACE ROBOTICS AND MECHANICS THE ABUNDANCE OF THOROUGHLY TESTED GENERAL ALGORITHMS AND MATLAB CODES PROVIDE THE READER WITH THE PRACTICE NECESSARY TO MASTER THIS INHERENTLY DIFFICULT SUBJECT WHILE THE REALISTIC ENGINEERING PROBLEMS AND EXAMPLES KEEP THE MATERIAL INTERESTING AND RELEVANT FEATURES BENEFITS COVERS DYNAMIC PROGRAMMING RELATING IT TO THE CALCULUS OF VARIATIONS AND OPTIMAL CONTROL AND NEIGHBORING OPTIMUM CONTROL DIFFERENTIAL DYNAMIC PROGRAMMING A PRACTICAL METHOD FOR NONLINEAR FEEDBACK

CONTROL INCLUDES A DISK THAT CONTAINS 40 GRADIENT AND SHOOTING CODES AS WELL AS CODES THAT SOLVE THE TIME VARYING RICCATI EQUATION THE DYNOPT TOOLBOX THESE CODES HAVE BEEN THOROUGHLY TESTED ON HUNDREDS OF PROBLEMS CONTAINS MANY REALISTIC EXAMPLES AND PROBLEMS SOLUTIONS TO THE EXAMPLES AND PROBLEMS AS WELL AS THE CODES THAT PRODUCE THE FIGURES ARE INCLUDED ON THE ACCOMPANYING DISK COVERS DYNAMIC OPTIMIZATION WITH INEQUALITY CONSTRAINTS AND SINGULAR ARCS USING INVERSE DYNAMIC OPTIMIZATION DIFFERENTIAL INCLUSION

HOW CAN THE VALUE OF DYNAMIC OPTIMIZATION TECHNOLOGY BE DEFINED IS A FULLY TRAINED TEAM FORMED SUPPORTED AND COMMITTED TO WORK ON THE DYNAMIC OPTIMIZATION TECHNOLOGY IMPROVEMENTS DO DYNAMIC OPTIMIZATION TECHNOLOGY RULES MAKE A REASONABLE DEMAND ON A USERS CAPABILITIES WHAT ARE SPECIFIC DYNAMIC OPTIMIZATION TECHNOLOGY RULES TO FOLLOW HOW DO WE ACCOMPLISH OUR LONG RANGE DYNAMIC OPTIMIZATION TECHNOLOGY GOALS THIS ONE OF A KIND DYNAMIC OPTIMIZATION TECHNOLOGY SELF ASSESSMENT WILL MAKE YOU THE ESTABLISHED DYNAMIC OPTIMIZATION TECHNOLOGY DOMAIN VETERAN BY REVEALING JUST WHAT YOU NEED TO KNOW TO BE FLUENT AND READY FOR ANY DYNAMIC OPTIMIZATION TECHNOLOGY CHALLENGE HOW DO I REDUCE THE EFFORT IN THE DYNAMIC OPTIMIZATION TECHNOLOGY WORK TO BE DONE TO GET PROBLEMS SOLVED HOW CAN I ENSURE THAT PLANS OF ACTION INCLUDE EVERY DYNAMIC OPTIMIZATION TECHNOLOGY TASK AND THAT EVERY DYNAMIC OPTIMIZATION TECHNOLOGY OUTCOME IS IN PLACE HOW WILL I SAVE TIME INVESTIGATING STRATEGIC AND TACTICAL OPTIONS AND ENSURING DYNAMIC OPTIMIZATION TECHNOLOGY COSTS ARE LOW HOW CAN I DELIVER TAILORED DYNAMIC OPTIMIZATION TECHNOLOGY ADVICE INSTANTLY WITH STRUCTURED GOING FORWARD PLANS THERE S NO BETTER GUIDE THROUGH THESE MIND EXPANDING QUESTIONS THAN ACCLAIMED BEST SELLING AUTHOR GERARD BLOKDYK BLOKDYK ENSURES ALL DYNAMIC OPTIMIZATION TECHNOLOGY ESSENTIALS ARE COVERED FROM EVERY ANGLE THE DYNAMIC OPTIMIZATION TECHNOLOGY SELF ASSESSMENT SHOWS SUCCINCTLY AND CLEARLY THAT WHAT NEEDS TO BE CLARIFIED TO ORGANIZE THE REQUIRED ACTIVITIES AND PROCESSES SO THAT DYNAMIC OPTIMIZATION TECHNOLOGY OUTCOMES ARE ACHIEVED CONTAINS EXTENSIVE CRITERIA GROUNDED IN PAST AND CURRENT SUCCESSFUL PROJECTS AND ACTIVITIES BY EXPERIENCED DYNAMIC OPTIMIZATION TECHNOLOGY PRACTITIONERS THEIR MASTERY COMBINED WITH THE EASY ELEGANCE OF THE SELF ASSESSMENT PROVIDES ITS SUPERIOR VALUE TO YOU IN KNOWING HOW TO ENSURE THE OUTCOME OF ANY EFFORTS IN DYNAMIC OPTIMIZATION TECHNOLOGY ARE MAXIMIZED

WITH PROFESSIONAL RESULTS YOUR PURCHASE INCLUDES ACCESS DETAILS TO THE DYNAMIC OPTIMIZATION TECHNOLOGY SELF ASSESSMENT DASHBOARD DOWNLOAD WHICH GIVES YOU YOUR DYNAMICALLY PRIORITIZED PROJECTS READY TOOL AND SHOWS YOU EXACTLY WHAT TO DO NEXT YOUR EXCLUSIVE INSTANT ACCESS DETAILS CAN BE FOUND IN YOUR BOOK YOU WILL RECEIVE THE FOLLOWING CONTENTS WITH NEW AND UPDATED SPECIFIC CRITERIA THE LATEST QUICK EDITION OF THE BOOK IN PDF THE LATEST COMPLETE EDITION OF THE BOOK IN PDF WHICH CRITERIA CORRESPOND TO THE CRITERIA IN THE SELF ASSESSMENT EXCEL DASHBOARD AND EXAMPLE PRE FILLED SELF ASSESSMENT EXCEL DASHBOARD TO GET FAMILIAR WITH RESULTS GENERATION PLUS AN EXTRA SPECIAL RESOURCE THAT HELPS YOU WITH PROJECT MANAGING INCLUDES LIFETIME SELF ASSESSMENT UPDATES EVERY SELF ASSESSMENT COMES WITH LIFETIME UPDATES AND LIFETIME FREE UPDATED BOOKS LIFETIME UPDATES IS AN INDUSTRY FIRST FEATURE WHICH ALLOWS YOU TO RECEIVE VERIFIED SELF ASSESSMENT UPDATES ENSURING YOU ALWAYS HAVE THE MOST ACCURATE INFORMATION AT YOUR FINGERTIPS

INCORPORATING A NUMBER OF THE AUTHOR S RECENT IDEAS AND EXAMPLES DYNAMIC PROGRAMMING FOUNDATIONS AND PRINCIPLES SECOND EDITION PRESENTS A COMPREHENSIVE AND RIGOROUS TREATMENT OF DYNAMIC PROGRAMMING THE AUTHOR EMPHASIZES THE CRUCIAL ROLE THAT MODELING PLAYS IN UNDERSTANDING THIS AREA HE ALSO SHOWS HOW DIJKSTRA S ALGORITHM IS AN EXCELLENT EXAMPLE OF A DYNAMIC PROGRAMMING ALGORITHM DESPITE THE IMPRESSION GIVEN BY THE COMPUTER SCIENCE LITERATURE NEW TO THE SECOND EDITION EXPANDED DISCUSSIONS OF SEQUENTIAL DECISION MODELS AND THE ROLE OF THE STATE VARIABLE IN MODELING A NEW CHAPTER ON FORWARD DYNAMIC PROGRAMMING MODELS A NEW CHAPTER ON THE PUSH METHOD THAT GIVES A DYNAMIC PROGRAMMING PERSPECTIVE ON DIJKSTRA S ALGORITHM FOR THE SHORTEST PATH PROBLEM A NEW APPENDIX ON THE CORRIDOR METHOD TAKING INTO ACCOUNT RECENT DEVELOPMENTS IN DYNAMIC PROGRAMMING THIS EDITION CONTINUES TO PROVIDE A SYSTEMATIC FORMAL OUTLINE OF BELLMAN S APPROACH TO DYNAMIC PROGRAMMING IT LOOKS AT DYNAMIC PROGRAMMING AS A PROBLEM SOLVING METHODOLOGY IDENTIFYING ITS CONSTITUENT COMPONENTS AND EXPLAINING ITS THEORETICAL BASIS FOR TACKLING PROBLEMS

PRESENTS THE ELEMENTS OF A UNIFIED APPROACH TO OPTIMIZATION BASED ON NONSMOOTH ANALYSIS A TERM INTRODUCED IN THE 1970 S BY THE AUTHOR WHO IS A PIONEER IN THE FIELD BASED ON A SERIES OF LECTURES GIVEN AT A CONFERENCE AT EMORY UNIVERSITY IN 1986 THIS VOLUME PRESENTS ITS

SUBJECTS IN A SELF CONTAINED AND ACCESSIBLE MANNER THE TOPICS TREATED HERE HAVE BEEN IN AN ACTIVE STATE OF DEVELOPMENT FOCUSES MAINLY ON DETERMINISTIC OPTIMAL CONTROL THE CALCULUS OF VARIATIONS AND MATHEMATICAL PROGRAMMING IN ADDITION IT FEATURES A TUTORIAL IN NONSMOOTH ANALYSIS AND GEOMETRY AND DEMONSTRATES THAT THE METHOD OF VALUE FUNCTION ANALYSIS VIA PROXIMAL NORMALS IS A POWERFUL TOOL IN THE STUDY OF NECESSARY CONDITIONS SUFFICIENT CONDITIONS CONTROLLABILITY AND SENSITIVITY ANALYSIS THE DISTINCTION BETWEEN INDUCTIVE AND DEDUCTIVE METHODS THE USE OF HAMILTONIANS THE VERIFICATION TECHNIQUE AND PENALIZATION ARE ALSO EMPHASIZED

THIS WORK PROVIDES A UNIFIED AND SIMPLE TREATMENT OF DYNAMIC ECONOMICS USING DYNAMIC OPTIMIZATION AS THE MAIN THEME AND THE METHOD OF LAGRANGE MULTIPLIERS TO SOLVE DYNAMIC ECONOMIC PROBLEMS THE AUTHOR PRESENTS THE OPTIMIZATION FRAMEWORK FOR DYNAMIC ECONOMICS IN ORDER THAT READERS CAN UNDERSTAND THE APPROACH AND USE IT AS THEY SEE FIT INSTEAD OF USING DYNAMIC PROGRAMMING THE AUTHOR CHOOSES INSTEAD TO USE THE METHOD OF LAGRANGE MULTIPLIERS IN THE ANALYSIS OF DYNAMIC OPTIMIZATION BECAUSE IT IS EASIER AND MORE EFFICIENT THAN DYNAMIC PROGRAMMING AND ALLOWS READERS TO UNDERSTAND THE SUBSTANCE OF DYNAMIC ECONOMICS BETTER THE AUTHOR TREATS A NUMBER OF TOPICS IN ECONOMICS INCLUDING ECONOMIC GROWTH MACROECONOMICS MICROECONOMICS FINANCE AND DYNAMIC GAMES THE BOOK ALSO TEACHES BY EXAMPLES USING CONCEPTS TO SOLVE SIMPLE PROBLEMS IT THEN MOVES TO GENERAL PROPOSITIONS

AS AN OUTGROWTH OF THE ADVANCEMENT IN MODERN CONTROL THEORY DURING THE PAST 20 YEARS DYNAMIC MODELING AND ANALYSIS OF ECONOMIC SYSTEMS HAS BECOME AN IMPORTANT SUBJECT IN THE STUDY OF ECONOMIC THEORY RECENT DEVELOPMENTS IN DYNAMIC UTILITY ECONOMIC PLANNING AND PROFIT OPTIMIZA TION FOR EXAMPLE HAVE BEEN GREATLY INFLUENCED BY RESULTS IN OPTIMAL CONTROL STABILIZATION ESTIMATION OPTIMIZATION UNDER CONFLICTS MULTI CRITERIA OPTIMIZATION CONTROL OF LARGE SCALE SYSTEMS ETC THE GREAT SUCCESS THAT HAS BEEN ACHIEVED SO FAR IN UTILIZING MODERN CONTROL THEORY IN ECONOMIC SYSTEMS SHOULD BE ATTRIBUTED TO THE EFFORT OF CONTROL THEORISTS AS WELL AS ECONOMISTS COLLABORATION BETWEEN THE TWO GROUPS OF RESEARCHERS HAS PROVEN TO BE MOST SUCCESSFUL IN MANY INSTANCES NEVERTHELESS THE GAP BETWEEN THEM HAS EXISTED FOR SOME TIME WHEREAS A CONTROL THEORIST FREQUENTLY SETS UP A MATHEMATICALLY

FEASIBLE MODEL TO OBTAIN RESULTS THAT PERMIT ECONOMIC INTERPRETATIONS AN ECONOMIST IS CONCERNED MORE WITH THE FIDELITY OF THE MODEL IN REPRESENTING A REAL WORLD PROBLEM AND RESULTS THAT ARE OBTAINED THROUGH POSSIBLY LESS MATHEMATICAL ANALYSIS ARE DUE LARGELY TO ECONOMIC INSIGHT THE PAPERS APPEARING IN THIS VOLUME ARE DIVIDED INTO THREE PARTS IN PART I THERE ARE FIVE PAPERS ON THE APPLICATION OF CONTROL THEORY TO ECONOMIC PLANNING PART II CONTAINS FIVE PAPERS ON EXPLORATION EXPLOITA TION AND PRICING OF EXTRACTIVE NATURAL RESOURCES FINALLY IN PART III SOME RECENT ADVANCES IN LARGE SCALE SYSTEMS AND DECENTRALIZED CONTROL APPEAR

THIS BOOK PROVIDES A SERIES OF SYSTEMATIC THEORETICAL RESULTS AND NUMERICAL SOLUTION ALGORITHMS FOR DYNAMIC OPTIMIZATION PROBLEMS OF SWITCHED SYSTEMS WITHIN INFINITE DIMENSIONAL INEQUALITY PATH CONSTRAINTS DYNAMIC OPTIMIZATION OF PATH CONSTRAINED SWITCHED SYSTEMS IS A CHALLENGING TASK DUE TO THE COMPLEXITY FROM SEEKING THE BEST COMBINATORIAL OPTIMIZATION AMONG THE SYSTEM INPUT SWITCH TIMES AND SWITCHING SEQUENCES MEANWHILE TO ENSURE SAFETY AND GUARANTEE PRODUCT QUALITY PATH CONSTRAINTS ARE REQUIRED TO BE RIGOROUSLY SATISFIED I E AT AN INFINITE NUMBER OF TIME POINTS WITHIN A FINITE NUMBER OF ITERATIONS SEVERAL NOVEL METHODOLOGIES ARE PRESENTED BY USING DYNAMIC OPTIMIZATION AND SEMI INFINITE PROGRAMMING TECHNIQUES THE CORE ADVANTAGES OF OUR NEW APPROACHES LIE IN TWO FOLDS I THE SYSTEM INPUT SWITCH TIMES AND THE SWITCHING SEQUENCE CAN BE OPTIMIZED SIMULTANEOUSLY II THE PROPOSED ALGORITHMS TERMINATE WITHIN FINITE ITERATIONS WHILE COMING WITH A CERTIFICATION OF FEASIBILITY FOR THE PATH CONSTRAINTS IN THIS BOOK FIRST WE PROVIDE BRIEF SURVEYS ON DYNAMIC OPTIMIZATION OF PATH CONSTRAINED SYSTEMS AND SWITCHED SYSTEMS FOR SWITCHED SYSTEMS WITH A FIXED SWITCHING SEQUENCE WE PROPOSE A BI LEVEL ALGORITHM IN WHICH THE INPUT IS OPTIMIZED AT THE INNER LEVEL AND THE SWITCH TIMES ARE UPDATED AT THE OUTER LEVEL BY USING THE GRADIENT INFORMATION OF THE OPTIMAL VALUE FUNCTION CALCULATED AT THE OPTIMAL INPUT WE THEN PROPOSE AN EFFICIENT SINGLE LEVEL ALGORITHM BY OPTIMIZING THE INPUT AND SWITCH TIMES SIMULTANEOUSLY WHICH GREATLY REDUCES THE NUMBER OF NONLINEAR PROGRAMS AND THE COMPUTATIONAL BURDEN FOR SWITCHED SYSTEMS WITH FREE SWITCHING SEQUENCES WE PROPOSE A SOLUTION FRAMEWORK FOR DYNAMIC OPTIMIZATION OF PATH CONSTRAINED SWITCHED SYSTEMS BY EMPLOYING THE VARIANT 2 OF

GENERALIZED BENDERS DECOMPOSITION TECHNIQUE IN THIS FRAMEWORK WE ADOPT TWO DIFFERENT SYSTEM FORMULATIONS IN THE PRIMAL AND MASTER PROBLEM CONSTRUCTION AND EXPLICITLY CHARACTERIZE THE SWITCHING SEQUENCES BY INTRODUCING A BINARY VARIABLE FINALLY WE PROPOSE A MULTI OBJECTIVE DYNAMIC OPTIMIZATION ALGORITHM FOR LOCATING APPROXIMATED LOCAL PARETO SOLUTIONS AND QUANTITATIVELY ANALYZE THE APPROXIMATION OPTIMALITY OF THE OBTAINED SOLUTIONS THIS BOOK PROVIDES A UNIFIED FRAMEWORK OF DYNAMIC OPTIMIZATION OF PATH CONSTRAINED SWITCHED SYSTEMS IT CAN THEREFORE SERVE AS A USEFUL BOOK FOR RESEARCHERS AND GRADUATE STUDENTS WHO ARE INTERESTED IN KNOWING THE STATE OF THE ART OF DYNAMIC OPTIMIZATION OF SWITCHED SYSTEMS AS WELL AS RECENT ADVANCES IN PATH CONSTRAINED OPTIMIZATION PROBLEMS IT IS A USEFUL SOURCE OF UP TO DATE OPTIMIZATION METHODS AND ALGORITHMS FOR RESEARCHERS WHO STUDY SWITCHED SYSTEMS AND GRADUATE STUDENTS OF CONTROL THEORY AND CONTROL ENGINEERING IN ADDITION IT IS ALSO A USEFUL SOURCE FOR ENGINEERS WHO WORK IN THE CONTROL AND OPTIMIZATION FIELDS SUCH AS ROBOTICS CHEMICAL ENGINEERING AND INDUSTRIAL PROCESSES

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