

1. Record Nr.	UNINA9910830204103321
Autore	Rubin Olis
Titolo	Computer models of process dynamics : from Newton to energy fields / / Olis Harold Rubin
Pubbl/distr/stampa	Hoboken, N.J. : , : John Wiley & Sons, Incorporated, , [2023] ©2023
ISBN	1-119-88568-X 1-119-88566-3 1-119-88567-1
Descrizione fisica	1 online resource (xiv, 302 pages) : illustrations
Disciplina	294.33653
Soggetti	Physics - Data processing Engineering - Data processing Economics - Data processing
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Nota di bibliografia	Includes bibliographical references and index.
Nota di contenuto	Cover -- Title Page -- Copyright Page -- Contents -- Chapter 1 Introduction -- 1.1 Engineering uses of computer models -- 1.1.1 Mission statement -- 1.2 The subject matter -- 1.3 Mathematical material -- 1.4 Some remarks -- Bibliography -- Chapter 2 From Computer Hardware to Software -- 2.1 Introduction -- 2.2 Computing machines -- 2.2.1 The software interface -- 2.3 Computer programming -- 2.3.1 Algebraic expressions -- 2.3.2 Math functions -- 2.3.3 Computation loops -- 2.3.4 Decision making -- 2.3.5 Graphics -- 2.3.6 User defined functions -- 2.4 State transition machines -- 2.4.1 A binary signal generator -- 2.4.2 Operational control of an industrial plant -- 2.5 Difference engines -- 2.5.1 Difference equation to calculate compound interest -- 2.6 Iterative programming -- 2.6.1 Inverse functions -- 2.7 Digital simulation of differential equations -- 2.7.1 Rectangular integration -- 2.7.2 Trapezoidal integration -- 2.7.3 Second-order integration -- 2.7.4 An Example -- 2.8 Discussion -- Exercises -- References -- Chapter 3 Creative thinking and scientific theories -- 3.1 Introduction -- 3.2 The dawn of astronomy -- 3.3 The renaissance -- 3.3.1 Galileo -- 3.3.2

Newton -- 3.4 Electromagnetism -- 3.4.1 Magnetic fields -- 3.4.2 Electromagnetic induction -- 3.4.3 Electromagnetic radiation -- 3.5 Aerodynamics -- 3.5.1 Vector flow fields -- 3.6 Discussion -- References -- Chapter 4 Calculus and the computer -- 4.1 Introduction -- 4.2 Mathematical solution of differential equations -- 4.3 From physical analogs to analog computers -- 4.4 Picard's method for solving a nonlinear differential equation -- 4.4.1 Mechanization of Picard's method -- 4.4.2 Feedback model of the differential equation -- 4.4.3 Approximate solution by Taylor series -- 4.5 Exponential functions and linear differential equations.  
4.5.1 Taylor series to approximate exponential functions -- 4.6 Sinusoidal functions and phasors -- 4.6.1 Taylor series to approximate sinusoids -- 4.7 Bessel's equation -- 4.8 Discussion -- Exercises -- Bibliography -- Chapter 5 Science and computer models -- 5.1 Introduction -- 5.2 A planetary orbit around a stationary Sun -- 5.2.1 An analytic solution for planetary orbits -- 5.2.2 A difference equation to model planetary orbits -- 5.3 Simulation of a swinging pendulum -- 5.3.1 A graphical construction to show the motion of a pendulum -- 5.3.2 Truncation and roundoff errors -- 5.4 Lagrange's equations of motion -- 5.4.1 A double pendulum -- 5.4.2 A few comments -- 5.4.3 Modes of motion of a double pendulum -- 5.4.4 Structural vibrations in an aircraft -- 5.5 Discussion -- Exercises -- Bibliography -- Chapter 6 Flight simulators -- 6.1 Introduction -- 6.2 The motion of an aircraft -- 6.2.1 The equations of motion -- 6.3 Short period pitching motion -- 6.3.1 Case study of short period pitching motion -- 6.3.2 State equations of short period pitching -- 6.3.3 Transfer functions of short period pitching -- 6.3.4 Frequency response of short period pitching -- 6.4 Phugoid motion -- 6.5 User interfaces -- 6.6 Discussion -- Exercises -- Bibliography -- Chapter 7 Finite element models and the diffusion of heat -- 7.1 Introduction -- 7.2 A thermal model -- 7.2.1 A finite element model based on an electrical ladder network -- 7.2.2 Free settling from an initial temperature profile -- 7.2.3 Step response test -- 7.2.4 State space model of diffusion -- 7.3 A practical application -- 7.4 Two-dimensional steady-state model -- 7.5 Discussion -- Exercises -- Bibliography -- Chapter 8 Wave equations -- 8.1 Introduction -- 8.2 Energy storage mechanisms -- 8.2.1 Partial differential equation describing propagation in a transmission line. 8.3 A finite element model of a transmission line -- 8.4 State space model of a standing wave in a vibrating system -- 8.4.1 State space model of a multiple compound pendulum -- 8.5 A two-dimensional electromagnetic field -- 8.6 A two-dimensional potential flow model -- 8.7 Discussion -- Exercises -- Bibliography -- Chapter 9 Uncertainty and softer science -- 9.1 Introduction -- 9.2 Empirical and ``black box'' models -- 9.2.1 An imperfect model of a simple physical object -- 9.2.2 Finite impulse response models -- 9.3 Randomness within computer models -- 9.3.1 Random number generators and data analysis -- 9.3.2 Statistical estimation and the method of least squares -- 9.3.3 A state estimator -- 9.3.4 A velocity estimator -- 9.3.5 An FIR filter -- 9.4 Economic, Geo-, Bio-, and other sciences -- 9.4.1 A pricing strategy -- 9.4.2 The productivity of money -- 9.4.3 Comments on business models -- 9.5 Digital images -- 9.5.1 An image processor -- 9.6 Discussion -- Exercises -- Bibliography -- Chapter 10 Computer models in a development project -- 10.1 Introduction -- 10.1.1 The scope of this chapter -- 10.2 A motor drive model -- 10.2.1 A conceptual model -- 10.2.2 The motor drive parameters -- 10.2.3 Creating the simulation model -- 10.2.4 The electrical and mechanical subsystems -- 10.2.5 System integration -- 10.2.6 Configuration management -- 10.3 The definition phase -- 10.3.1

Selection of the motor -- 10.3.2 Simulation of load disturbances --  
10.4 The design phase -- 10.4.1 Calculation of frequency response --  
10.4.2 The current control loop -- 10.4.3 Design review and further  
actions -- 10.4.4 Rate feedback -- 10.5 A setback to the project --  
10.5.1 Elastic coupling between motor and load -- 10.6 Discussion --  
Exercises -- Bibliography -- Chapter 11 Postscript -- 11.1 Looking  
back -- 11.2 The operation f a imulation facility.-- 11.3 Looking  
forward -- Bibliography -- Appendix A Frequency response methods  
-- Appendix B Vector analysis -- Appendix C Scalar and vector fields  
-- Appendix D Probability and statistical models -- Index -- EULA.

### Sommario/riassunto

"The subject of computer modeling evolved from analog computing, which gained its majority in the mid twentieth century and was then superseded by digital simulation. In the next five years computer models will serve as the engine that simulates virtual reality within a user interface that exploits the products of the computer games industry. The future may include the increasing use of 3D displays with animation, and computer inputs that come from the user via 3D digital cameras"--