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Disciplina	006.22
Soggetti	Mathematical logic Artificial intelligence Control engineering Robotics Mechatronics Quality control Reliability Industrial safety Mathematical Logic and Formal Languages Artificial Intelligence Mathematical Logic and Foundations Control, Robotics, Mechatronics Quality Control, Reliability, Safety and Risk
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Nota di bibliografia	Includes bibliographical references and index.
Nota di contenuto	Cyberphysical Systems: Introduction -- Differential Equations and Domains -- Choice and Control -- Safety and Contracts -- Dynamical Systems and Dynamic Axioms -- Truth and Proof -- Control Loops and Invariants -- Events and Responses -- Reactions and Delays -- Differential Equations and Differential Invariants -- Differential Equations and Proofs -- Ghosts and Differential Ghosts -- Logical Foundations and CPS -- Differential Invariants and Proof Theory -- Verified Models and Verified Runtime Validation -- Hybrid Systems and Games -- Winning Strategies and Regions -- Winning and Proving Hybrid Games -- Game Proofs and Separations -- Virtual Substitution

	and Real Equations -- Virtual Substitution and Real Arithmetic -- Axioms and Uniform Substitutions -- Differential Axioms and Uniform Substitutions -- Model Checking and Reachability Analysis -- Distributed Systems and Hybrid Systems.
Sommario/riassunto	Cyber-physical systems (CPSs) combine cyber capabilities, such as computation or communication, with physical capabilities, such as motion or other physical processes. Cars, aircraft, and robots are prime examples, because they move physically in space in a way that is determined by discrete computerized control algorithms. Designing these algorithms is challenging due to their tight coupling with physical behavior, while it is vital that these algorithms be correct because we rely on them for safety-critical tasks. This textbook teaches undergraduate students the core principles behind CPSs. It shows them how to develop models and controls; identify safety specifications and critical properties; reason rigorously about CPS models; leverage multi-dynamical systems compositionality to tame CPS complexity; identify required control constraints; verify CPS models of appropriate scale in logic; and develop an intuition for operational effects. The book is supported with homework exercises, lecture videos, and slides.