

Foreword

The asynchronous machine, also known as the induction machine, has been an industry workhorse for more than 120 years. The first rotating machine to work using alternating current, its advent started a new chapter in the evolution of our society, with the propagation of long-distance electrical lines ensuring a large distribution of electrical energy and a systematic replacement of steam-powered machines with electrical ones. This expansion still continues today, as much in industrial applications and transport as home automation. The induction machine is a part of our everyday lives in the broadest sense: it is present in all Western households and emerging and developing countries strongly depend on its use.

Naturally, since its first appearance, the induction motor has undergone revolutions and changes through the development of techniques and progress in the field of magnetic or dielectric materials. This can easily be seen from the size of the machines, with a power-to-mass ratio that has considerably evolved and can operate at variable speeds, which makes it a broad-spectrum actuator. The intrinsic performances of this machine have considerably progressed, first through a more optimized construction of its structure and by the use of better quality materials, but mostly from the set-up of an adapted electronic environment allowing the optimized management of energy processing.

To this end, this book by Professor Hubert Razik provides an eloquent and original testimonial by discussing in an educational and rational way all the constituent elements of a variable speed drive at the base of the asynchronous machine. In this way we can easily navigate between methods and tools, principles and rules in order to cover all the angles of modern control of this machine, by making the link between signal processing, control and diagnostics.

This book is split into six chapters and accompanied by a bibliography consisting of the greatest contributions to the field.

Chapter 1 covers sensors and electrical measurements and brings to light, in a concise way, the notions of coding and restitution of information that can be read by a controller.

Chapter 2 clarifies the fundamental elements for the control of the systems, through a review of the representation and synthesis of corrector tools in the context of electric motor control (identification, nonlinear control, stability, data quantization, etc.).

Chapter 3 covers the modeling of induction motors, with a gradual evolution from simple models valid in nominal cases, up to taking into account very unusual phenomena such as magnetic saturation, rotor eccentricity or thermal incidence. It contains a very explicit and relevant contribution.

Chapter 4, the longest of all, splits speed variation into its different aspects. It discusses scalar, then vector control, then passes through direct torque control and controls without mechanical sensors. This part is subject to several declinations, be it over the phases of the motor (five- or six-phase motor) or even over the number of inverter output levels (three level, four or multi-level). This chapter is even more valuable since it is based on the real know-how of the author. It is the result of long and meticulous practice, searching for better solutions.

Chapter 5 covers fuzzy logic, by simply setting down the meets and bounds of this approach and its applications for control of the asynchronous motor. The basis is carefully shown, allowing quick and relevant applications for the given potentials.

The final chapter – Chapter 6 – covers the delicate problem of diagnostics of electric motors, which is currently the subject of ever more numerous and open research. Professor Razik's contribution to the field is very well developed. He has compiled an inventory of different problems and proposed methods of detecting and identifying defects. Ultimately, machine monitoring is proposed via the use of wireless communication.

The author's educational background is present throughout this book. For completion, the book proposes a series of corrected exercises that allow the assimilation of the concepts needed for this discipline.

The operation and diagnostics of electric motors, such as induction motors, remains a very complex discipline since it brings into play conversion and processing phenomena of electrical energy with a distinct nonlinear character. This is an example of an application that joins significant know-how and we thank Professor Razik for this accessible work, demystifying the laws of control and diagnostics of these devices.

This book will be useful for postgraduate students, engineering students, their tutors and other young researchers starting a career in this field where much progress is awaited. The interconnection of the notions covered make this a complete book for the field of electric motors.

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