# Preface

The traditional computed torque design is only adequate for the control of robot manipulators with precisely known dynamics. In the industrial environment, however, an accurate robot model is not generally available, and most robots are limited to be operated under slow motion conditions so that some system dynamics can be ignored. When performing the tasks with precise tracking of fast trajectories under time-varying payloads, several considerations such as the joint flexibility and actuator dynamics are unavoidable. This will generally lead to some extremely complex robot model which greatly increases the difficulty in the controller design. What is worse is that estimation of the system parameters in this complex model becomes more challenging. It is reasonable to regard some system dynamics as uncertainties to simplify the modeling tasks. The robust controls and adaptive designs are then utilized to deal with these uncertainties. However, the former needs the knowledge of the variation bounds for the uncertainties, while the later requires the linear parameterization of the uncertainties into a known regressor multiplied by an unknown constant parameter vector. When the system contains time-varying uncertainties whose variation bounds are not given (defined later as general uncertainties), both the robust control and adaptive design are not feasible in general.

In the conventional adaptive control of robot manipulators, the robot model is assumed to be linearly parameterizable into the regressor form. But the derivation of the regressor matrix is tedious in most cases, and computation of the regressor matrix during each sampling period in the real-time realization is too time-consuming. This suggests the need for some regressor-free adaptive designs.

The aim of this book is to address recent developments of the unified regressor-free adaptive controller designs for robot manipulators with consideration of joint flexibility and actuator dynamics. The unified approach is still valid for the robot control in the compliant motion environment. The main tool used in this new design is the function approximation technique which represents the general uncertainties in the robot model as finite combinations of basis functions weighted with unknown constant coefficients.

The book has been written as a text suitable for postgraduate students in the advanced course for the control of robot manipulators. In addition, it is also intended to provide valuable tools for researches and practicing engineers who currently employ the regressor-based algorithms but would benefit significantly from the use of the regressor-free strategies.

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