This thesis is concerned with parametric system identification for linear multivariable systems using matrix fraction description.

The two forms of matrix fraction description (left and right) are investigated to perform system identification.

Single-input single-output methods such as ordinary least squares, generalized least squares extended least squares, maximum likelihood, instrumental variables, four step instrumental variable, simplified refined instrumental variable, linear multistage auto regressive moving average with exogenous input, recursive least squares, recursive extended least squares are first implemented, then extensions are performed to multiple input multiple output systems using left matrix fraction description (LMFD).

Moreover Monte Carlo simulations and comparisons are performed on some of these algorithms.

For right matrix fraction descriptions (RMFD) identification, nonlinear optimization approaches are proposed such as the constrained prediction error method and the reference model method whereas for diagonal right matrix fraction description models, an iterative least squares is attempted. A frequency domain approach is also investigated for both LMFD and RMFD.

Finally identification is performed for control purposes on an industrial process to achieve reference tracking for a four tank hydraulic system.