# ID10 ARARMA(X) Identification

## 10.3 ESTIMATION OF ARARMAX MODELS

Any ARARMAX model can be considered as equivalent to the ARMAX model

$$q^*(z^{-1})\, y(t) = p^*(z^{-1})\, u(t) + r(z^{-1})\, w(t) \tag{10.3.1}$$

and identified with the procedures already described in the ARMAX case; relation (10.2.1) shows that the knowledge of $q^*(z^{-1})$, $p^*(z^{-1})$ and $r(z^{-1})$ allows a predictive use of the model. The direct estimation of $q^*(z^{-1})$ and $p^*(z^{-1})$ does not allow however, to extract any common factor, $r(z^{-1})$, because of the inevitable estimation errors. When the identification is not oriented to prediction it is thus necessary to use other approaches, like IV methods. The simplest instruments that can be used are past inputs

$$\eta(t) = u(t - n^*) \tag{10.3.2}$$

but better results can be obtained using instruments generated with an approximate model of the deterministic part of the process, obtained with least squares or with initial instruments (10.3.2); iterating the procedure leads usually to a rapid convergence. The availability of $q(z^{-1})$ and $p(z^{-1})$ allows computing the sequence of equation errors

$$e(t) = q(z^{-1})\, y(t) - p(z^{-1})\, u(t) \tag{10.3.3}$$

that can be modeled as an ARMA process in order to obtain the estimates of $r(z^{-1})$ and $s(z^{-1})$. The whole model can then be validated performing a whiteness test on its residuals and/or a test on the correlation between its residuals and the input sequence.