model error itself can be used to determine the dominant modes. Moreover, the simplicity of the computations do not presume any special properties of the system, such as small damping and orthogonal symmetry. (6 refs.) [29]

37165 Focusing based on the structure of a model in model-based diagnosis. P.Nooteboom (Dept. of Comput. Sci., Enschede, Netherlands), G.B.Leemeijer. *Int. J. Man-Mach. Stud. (UK)*, vol.38, no.3, p.455-74 (March 1993).
The high computational complexity of existing methods for model-based diagnosis imposes a limit on the application of those methods in practical situations. Therefore, a lot of research time on methods that improve the tractability of model-based diagnosis. In this paper, a new method for improving the tractability of model-based diagnosis is presented. The reasoning mechanism used is restricted to a subset of the components in the model called the focus. The focus is selected during diagnosis, based on (1) the structure of the model and the observed values at the system outputs, and (2) measurable connections in the model. Experiments have shown that focusing improves the practical applicability of model-based diagnosis. Furthermore, the authors discuss a method for ordering the resulting set of diagnoses in a way analagous to determining a focus, i.e. based on the structure of the model and observations available. (14 refs.) [30]

37166 Nonlinear system identification using spatiotemporal neural networks. A.Atiya (Dynamica, Inc., Houston, TX, USA), A.Parlos.
IJCNN International Joint Conference on Neural Networks (Cat. No.92CH3114-6), Baltimore, MD, USA, 7-11 June 1992 (New York, NY, USA: IEEE 1992), p.504-9 vol.2
The so-called spatiotemporal neural network is considered. This is a neural network where the conventional weight multiplication operation is replaced by a linear filtering operation. A training algorithm is derived for such networks. The problem of nonlinear system identification is considered as an application for spatiotemporal networks. Nonlinear system identification is one of the problems in the systems area, with limited success for results based on conventional methods. Neural network approaches are encouraging, but further exploration is needed. The capability of the spatiotemporal neural networks to identify nonlinear systems is explored through a simple example using the derived learning rule. The simulation results are encouraging, though testing of the identification method on a real-world system is still under investigation. (10 refs.) [31]

37167 On the generation of an optimally robust residual signal for systems with structured model uncertainty. S.Daley (GEC-Alsthom, Whetstone, UK), H.Wang.
Proceedings of the 1992 American Control Conference (IEEE Cat. No.92CH3072-6), Chicago, IL, USA, 24-26 June 1992 (Evanston, IL, USA: American Autom. Control Council 1992), p.2104-8 vol.3
The recently developed parametric design for observer gain matrices is used to formulate an optimally robust signal for fault diagnosis in systems with structured model uncertainty. Using the available free parameters inside the observer gain matrix and with a proper choice of performance function, it is shown that a residual signal can be obtained which is insensitive to the model uncertainty and sensitive to the faults of the system. A simulation for a fifth-order system is carried out, and good results are obtained. (12 refs.) [32]

37168 Performance prediction of the interacting multiple model algorithm. X.R.Li, Y.Bar-Shalom (Dept. of Electr. & Syst. Eng., Connecticut Univ., Storrs, CT, USA).
Proceedings of the 1992 American Control Conference (IEEE Cat. No.92CH3072-6), Chicago, IL, USA, 24-26 June 1992 (Evanston, IL, USA: American Autom. Control Council 1992), p.2109-13 vol.3
An effective approach to nonsimulation performance prediction of the interacting multiple model algorithm is presented. This approach is based on a stochastic performance measure (i.e., conditional expectation of the error covariance) of hybrid nature in the sense that it is a continuous-valued matrix function of a discrete-valued sequence—the system mode sequence. This system mode sequence is an essential description of the scenario of the problem on which the performance of the algorithm is dependent and being predicted. The performance measure is efficiently calculated in an offline recursion. The capability of this approach in predicting quantitatively the average performance of the algorithm is illustrated via two important examples: a generic air traffic control tracking problem and a nonstationary noise identification problem. The predicted performance given by this approach agrees remarkably well with the simulated one, which verifies the good accuracy of the approach. (25 refs.) [33]

37169 Output prediction in presence of systematic model mismatch. M.Agarwal (Eidgenossische Tech. Hochschule, Zurich, Switzerland).
Proceedings of the 1992 American Control Conference (IEEE Cat. No.92CH3072-6), Chicago, IL, USA, 24-26 June 1992 (Evanston, IL, USA: American Autom. Control Council 1992), p.2435-9 vol.3
A novel identification method is presented for optimally predicting online the future outputs of discrete-time nonlinear systems in the face of systematic measurement errors and parameter drifts, without requiring any user-specified tuning. The method estimates, over a relatively small data window, time-varying parameter values that minimize a measure of total a priori prediction error in such a way that, at each data point, the a posteriori error lies within the corresponding a priori errors. Simulation of a two-parameter linear system demonstrates the ability of the method to perform optimally, without user interference, for both systematic measurement error and systematic parameter drift. The proposed method is shown to be superior to the popular tuning-dependent methods, which require the user to divine a priori the unknown, possibly time-varying, nature of the mismatch. (2 refs.) [34]

37170 Hard and tight upper bounds on the model uncertainty in linear estimation of restricted complexity models. E.-W.Bai (Dept. of Electr. & Comput. Eng., Iowa Univ., Iowa City, IA, USA).
Proceedings of the 1992 American Control Conference (IEEE Cat. No.92CH3072-6), Chicago, IL, USA, 24-26 June 1992 (Evanston, IL, USA: American Autom. Control Council 1992), p.2440-4 vol.3
The author considers the problem of uncertainty quantification in linear estimates of restricted complexity models. The plant identifier and the uncertainty identifier run in parallel. While the plant identifier provides an optimal estimate in some sense, the bound on the difference between this estimate and the true system is characterized by a sequence of rational functions generated by the uncertainty identifier. The importance of this sequence is that each member of this sequence is truly a hard upper bound of the uncertainty in L_2 sense independent of the order of the approximant. Moreover, as the order n of the approximant increases, the bound derived gets tighter and eventually converges to the actual uncertainty bound as $n \rightarrow \infty$. Thus, in estimation of restricted complexity models, the possibly conflicting goals of providing an optimal estimate as well as a hard upper bound on the model uncertainty are resolved by dividing the traditional identifier into two parts: the plant identifier and the uncertainty identifier. (16 refs.) [35]

37171 Parameter identification of systems with uncertain dynamics and disturbances. Fu-Ming Lee, I-Kong Fu, Li-Chen Fu (Nat. Taiwan Univ., Taipei, Taiwan).
Proceedings of the 1992 American Control Conference (IEEE Cat. No.92CH3072-6), Chicago, IL, USA, 24-26 June 1992 (Evanston, IL, USA: American Autom. Control Council 1992), p.2445-9 vol.3
A method is presented for parameter identification of systems with uncertain dynamics and input/output disturbances. The system model is in stable factor form and is assumed to contain both parametric and nonparametric uncertainty. However, only parametric uncertainty, in the form of unknown parameters, is identified from the available input/output data, which are contaminated by norm-bounded nonparametric uncertainty and disturbances. A finite-time energy bound of the perturbation due to nonparametric uncertainty and disturbances is constructed in real time and is used in the parameter identification algorithm to ensure monotone reduction of parameter errors. A numerical example is given to support the theoretical results. (17 refs.) [36]

37172 Block-recursive identification of parameters and delay in the presence of noise. G.E.Young (Sch. of Mech. & Aerosp. Eng., Oklahoma State Univ., Stillwater, OK, USA), K.S.S.Rao, V.R.Chatufale.
Proceedings of the 1992 American Control Conference (IEEE Cat. No.92CH3072-6), Chicago, IL, USA, 24-26 June 1992 (Evanston, IL, USA: American Autom. Control Council 1992), p.2450-4 vol.3
A method for identification of parameters and delays of a linear system in the presence of noise is presented. The estimation procedure is based on transforming the input-output data into the discrete Fourier domain. The transformed data are then solved block-recursively to obtain both the system parameters and the unknown delay. For systems with no delays or known delays, the equations are linear in the parameters and the standard estimation techniques can be applied. For systems with unknown delays, the resulting equations are nonlinear in the delay term. A recursive nonlinear estimation technique similar to the least-squares in the time domain has been developed. In the presence of Gaussian white noise, simulation studies indicate that the parameters converge to their true values in the mean. (14 refs.) [37]

37173 Identification of a distributed parameter (conductivity) in a system governed by a parabolic equation: uniqueness and stability results. G.Crosta (Dept. of Inf. Sci., Milan Univ., Italy).
Proceedings of the 1992 American Control Conference (IEEE Cat. No.92CH3072-6), Chicago, IL, USA, 24-26 June 1992 (Evanston, IL, USA: American Autom. Control Council 1992), p.2455-62 vol.3
The parameter identification problem considered consists of identifying measurable, bounded, and strictly positive position-dependent conductivity from interior potential measurements in one spatial dimension. At least one solution is assumed to exist. Since conductivity satisfies a first-order ordinary differential equation, uniqueness follows from stating either a regular or a singular initial value problem. The unifying element is the Cauchy problem for the defect equation. Two different integration procedures are applied to the latter, according to whether uniqueness is due to a regular or a singular problem. Standard stability theory applies to the former and leads to L^∞-estimates, provided Gronwall-Bellmans inequality is extended to measurable functions. Singular problems yield at most L^1-stability estimates. (15 refs.) [38]

37174 A Hopfield-based neuro-diagnostic system. S.R.Chu, R.Shoureshi (Sch. of Mech. Eng., Purdue Univ., West Lafayette, IN, USA), A.J.Healy.
Proceedings of the 1992 American Control Conference (IEEE Cat. No.92CH3072-6), Chicago, IL, USA, 24-26 June 1992 (Evanston, IL, USA: American Autom. Control Council 1992), p.2629-33 vol.4
A high potential application area for neural networks in dynamic systems is the area of failure detection and identification. An innovation-based failure diagnostic is considered. This scheme requires a fast online system identification technique. Formulation and development of a recurrent Hopfield network for system identification are presented. The general case of a combined parameter identification and state observation is considered. (9 refs.) [39]

37175 Least squares identification and the robust strict positive real property. B.D.O.Anderson (Dept. of Syst. Eng., Australian Nat. Univ., Canberra, ACT, Australia), I.D.Landau.
Proceedings of the 1992 American Control Conference (IEEE Cat. No.92CH3072-6), Chicago, IL, USA, 24-26 June 1992 (Evanston, IL, USA: American Autom. Control Council 1992), p.2653-7 vol.4
The authors examine a robustness question relating to a strengthened SPR (strict positive real) condition. It is shown that, in the case of continuous-time systems, the existence question has the same answer as for the case of an unstrengthened SPR condition, while the construction procedure is more complicated, and can be expected to yield an answer containing more parameters. However, the robustness question for a strengthened discrete-time SPR condition remains unresolved. (7 refs.) [40]

37176 Statistical plant set estimation using Schroeder-phased multisinusoidal input design. D.S.Bayard (Jet Propulsion Lab., California Inst. of Technol., Pasadena, CA, USA).
Proceedings of the 1992 American Control Conference (IEEE Cat. No.92CH3072-6), Chicago, IL, USA, 24-26 June 1992 (Evanston, IL, USA: American Autom. Control Council 1992), p.2988-95 vol.4
A frequency domain method is developed for plant set estimation. The estimation of a plant 'set' rather than a point estimate is required to support many methods of modern robust control design. The approach here is based on using a Schroeder-phased multisinusoid input design which has the special property of placing input energy only at the discrete frequency points used in the computation. A detailed analysis of the statistical properties of the frequency domain estimator is given, leading to exact expressions for the probability distribution of the estimation error, and many important properties. It is shown that, for any nominal parametric plant estimate, one can use these results to construct an overbound on the additive uncertainty to any prescribed statistical confidence. The 'soft' bound thus obtained can be used to replace 'hard' bounds presently used in many robust control analysis and synthetic methods. (26 refs.) [41]

37177 Representational capabilities of multilayer feedforward networks with time-delay synapses. A.Back (DSTO, Salisbury, SA, Australia), A.C.Tsoi.
Proceedings of the 1992 American Control Conference (IEEE Cat. No.92CH3072-6), Chicago, IL, USA, 24-26 June 1992 (Evanston, IL, USA: American Autom. Control Council 1992), p.3064-5 vol.4
It is shown that a multilayer perceptron (MLP) with infinite impulse response (IIR) synapses can represent a class of nonlinear block-oriented systems. This includes the Wiener, Hammerstein, and sandwich (or cascade) systems. Additionally, the IIR MLP network overcomes the disadvantages of the Volterra series modeling method used previously for these systems. It also presents a method of structure identification for nonlinear systems which differs from existing methods. The significance of the IIR MLP is that a useful range of systems can be modeled by an architecture based on the MLP and adaptive filters. (12 refs.) [42]