A new approach for solving systems of nonlinear equations via a forecasting hybrid technique

Eleftheria N. Malihoutsaki[a], George S. Androulakis[b], and Theodoula N. Grapsa[a]

[a]Department of Mathematics, University of Patras,
Rio, GR-265.04, Greece

[b]Department of Business Administration, University of Patras,
Rio, GR-265.04, Greece

malihoutsaki_eri@yahoo.gr,gandroul@upatras.gr,grapsa@math.upatras.gr

Key words: nonlinear equations, ARMA models, time series forecasting.

Nonlinear problems are of interest to engineers, physicists and mathematicians because most physical systems are inherently nonlinear in nature. There is a class of methods for the numerical solution of a system of nonlinear equations which arise from iterative procedures. A feature of these repetitive processes is that they cannot use information from the path traced out from some/all previous points that finally leads to the solution of the system. Moreover, this sequence of points -generated by an iterative process- depends crucially on the nature of the involved nonlinear equations and the used iterative method.

Time series is a sequence of data points, measured typically at successive times spaced at uniform time intervals. Time series forecasting is the use of a model to forecast future events based on known past events; to predict data points before they are measured. Models for time series forecasting are the autoregressive (AR) models, the integrated (I) models, and the moving average (MA) models. These three classes depend linearly on previous data points. Combinations of these techniques produce autoregressive moving average (ARMA) and autoregressive integrated moving average (ARIMA) models.

Inspired by the idea of time series forecasting, in this paper, we treat the produced iterative points of any iterative process, at the last m steps, to be the known past events for the forecasting model. The proposed approach results to the next iteration of the iterative process, for every coordinate, through a hybrid way using a combination of the iterative process and the forecasting model of time series. Since the use of time series forecasting is an intermediate step in the iterative process it is necessary to take into account the complexity and the computational cost of this model. Thus, the simple ARMA models seem to be a good choice. Moreover, in order to avoid the recalculation of ARMA coefficients at each iteration, a recalculation of them is realized only when it is necessary.

Preliminary numerical examples on well-known test problems are promising.