

## **Acclimatizing Fast Orthogonal Search (FOS) Model for River Stream-flow Forecasting**

**We would like to thank the referee for his objective and thorough review of our paper. We have addressed all the referee's comments in the following point-by-point response. All changes made to accommodate the referee's comments are underlined in the revised manuscript.**

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### **Reviewer #2**

The paper presents an application of one of the data-driven approaches to monthly flow forecasting of the River Nile flow at Aswan High Dam. The authors state that the objective of their paper is to “investigate the potential of utilizing the Fast Orthogonal Search (FOS) method to develop stream-flow forecasting model that achieve consistent and reliable accuracy levels”.

The title of the paper and its objective stated by the authors suggest that using FOS is a requirement for developing a consistent and reliable forecasting model, whilst in truth it is just one of many possible techniques used in system identification and for training neural network-based models. For example, the authors could use Adaptive Orthogonal Search (Billings and Wei, 2008) for the same purpose.

### **Reply**

**The objective of the paper is to apply non-linear system identification to the problem of river stream-flow forecasting and compare its performance with Artificial Intelligence (AI) forecasting techniques. For this purpose, any powerful non-linear system identification technique can provide a proof of concept. However, the selection of FOS was motivated by its capabilities and its performance that was previously reported in (Korenberg, M. J. 1988, Osman et al (2010), Osman et al (2009)). FOS has been developed, validated and examined by the authors in variety of other applications and showed superior performane over other competitive methods. Other methods such as the “The Adaptive Orthogonal Search (Billings and Wei, 2008)” can be compared later to FOS to asses the performance of different non-linear system identification techniques which is not the main scope of this paper. For example, the main difference between FOS and AOS is the model terms selection and the model length determination criteria. We will consider carrying out this comparison in another publication to assess the**

**performance of orthogonal search methods and to evaluate FOS against other non-linear system identification techniques.**

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Osman A., **Noureldin A.**, El-Shafie A. and McGaughey D.: “Fast Orthogonal Search Approach for Distance Protection of Transmission Lines” Electric Power Systems Research, Elsevier, **V80** (2), pp: 215–221, Feb 2010.

*Osman A., **Noureldin A.**, El-Sheimy N., Theriault J. and Campbell S. “Improved Target Detection and Bearing Estimation Using Fast Orthogonal Search for Real-Time Spectral Analysis” Measurement Science and Technology, IoP, **V20** (6), June 2009 (14pp).*

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The paper is not clearly written and rather confusing. The authors formulate the forecasting problem as the Nonlinear Auto-Regressive Moving Average with eXogeneous inputs NARMAX model, but only one variable, flow rate is used. Therefore, the authors probably use a Nonlinear Auto-Regressive NLAR model. However, the reader can only guess which model is used because it is not presented in any detail and the authors themselves call it the FOS model.

**Reply**

**We thank the reviewer for this important comment and for pointing out this issue that may confuse the reader. In addition to proof reading to improve its quality, the paper has been better organized so that the above confusion is resolved. A paragraph is added and is underlined in the revised manuscript to clearly explain that, in this particular application, the FOS based model was reduced from NARMAX to a nonlinear autoregressive (NLAR) model. For the reviewer’s convenience, the added part is also included below.**

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The authors test three different training approaches for the identification of the polynomial relationship between past and future monthly flow rates using FOS system identification tools. There is no information on which computer package is used.

**Reply**

**The authors used MatLab to implement the FOS algorithm on a Core i7 (3.4 GHz) processor utilizing a 16GB RAM. This information is added in the revised manuscript.**

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The application of FOS is new in flow forecasting, at least to my knowledge, although it is a well-known technique in engineering applications. The authors present one application to the monthly flow forecasting of the River Nile, but they do not provide any new insight into the subject. In other words, it is not clear if this approach could be useful for other rivers and what we can learn from using it.

### **Reply**

**It is true that the utilization of orthogonal search techniques including FOS for stream flow forecasting is new and has not been applied before. The scope of the manuscript is to show the potential of FOS as forecaster for the river stream-flow. The same approach can be applied to other rivers. We have added two sentences in the conclusion section to explain the potential of using FOS in stream flow forecasting of other rivers. The added sentences is underlined in the revised manuscript.**

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Apart from the very poor language that requires serious editing, the paper could serve as a caricature of a scientific paper. I do not think the authors read what they wrote. There is a number of repetitions, the authors give lists of references that are not relevant, statements are wrong or meaningless (see specific comments). I suggest the authors refer to the paper of Billings and Wei (2008) to improve their paper-writing skills and submit a corrected version of the paper as a technical note to some other journal.

### **Reply**

**We thanks the reviewer for his observation and for commenting on the quality of the language of the paper. We revised the paper carefully to address his comment. It has gone through significant proof read and reorganization in order to improve both the structure and the language of the paper. Moreover, the list of references has been revised as per the reviewer comment. It has been modified to be more comprehensive and reprehensive to the citation made on the paper.**

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### **Specific comments:**

The title is not precise: I guess the authors meant “river flow forecasting”. I would suggest change “stream-flow” into “river flow” in the rest of the paper.

### **Reply**

**We thank the reviewer for his comment. However, the authors believe that the term stream-flow represents the flow of water in streams, rivers, and other channels, as defined the global hydrological cycle.**

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Page 1, lines 19-20: “In this paper, a novel model namely; Fast Orthogonal Search (FOS) model is proposed to develop river stream-flow forecasting.” This sentence states the FOS is novel which is not true. It was first published in 1989 by Korenberg (referred to by the authors) and it is not a model but an algorithm for system identification.

### **Reply**

**The authors agree with the reviewer in his comment. We revised the paper to show a novel forecasting approach based on Fast Orthogonal Search (FOS).**

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Page 2, line 9-10 repeats line 8-9.

Page 3, lines 10-20 and page 4 lines 1-10 are only two examples of very poor writing style mentioned in the general comments.

Page 4, equation (5): the  $f(m)$  function is not specified and therefore the model structure is not given.

### **Reply**

**The manuscript has been thoroughly reviewed and all the efforts have been made to make it free from errors. We have also made all necessary efforts to improve the structure and the organization of the paper and avoid any repetition.**

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