Optimal proton exchange membrane fuel cell modelling based on hybrid Teaching Learning Based Optimization Differential Evolution algorithm

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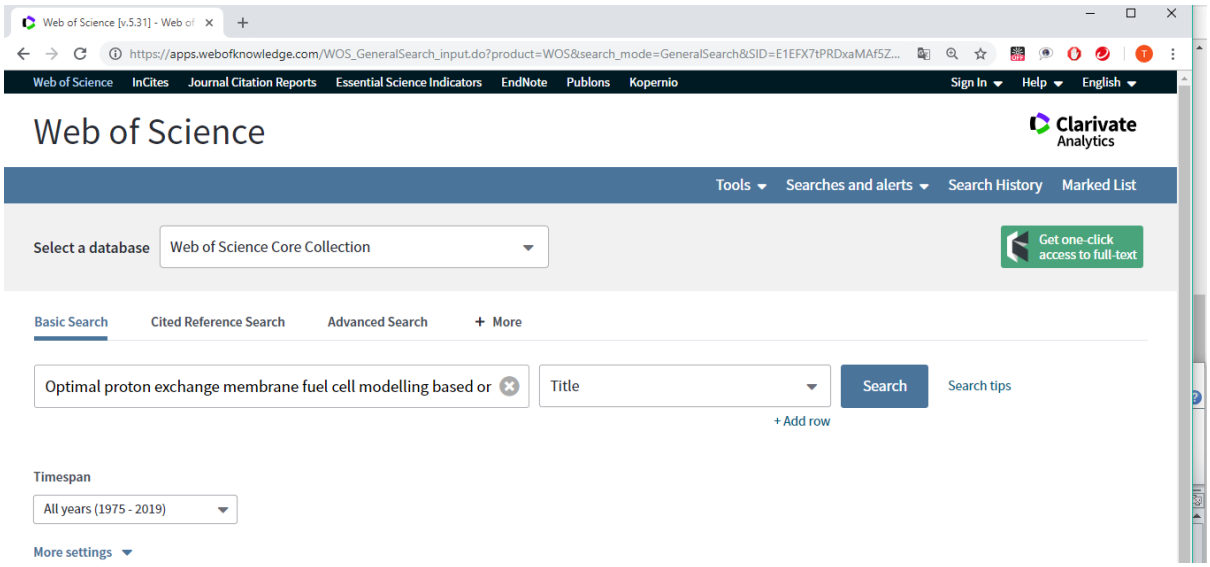

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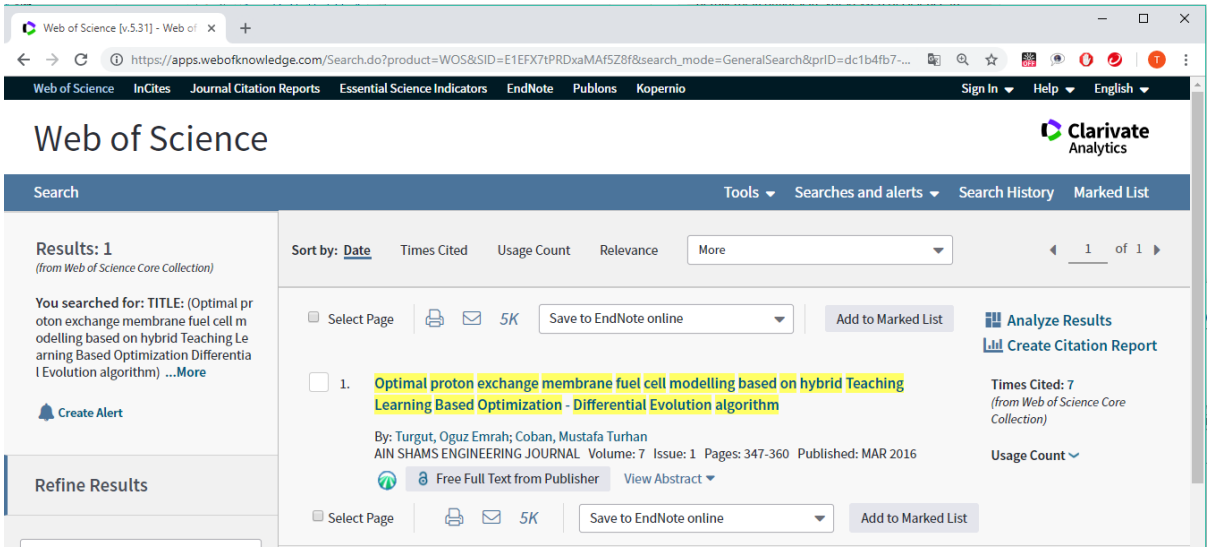

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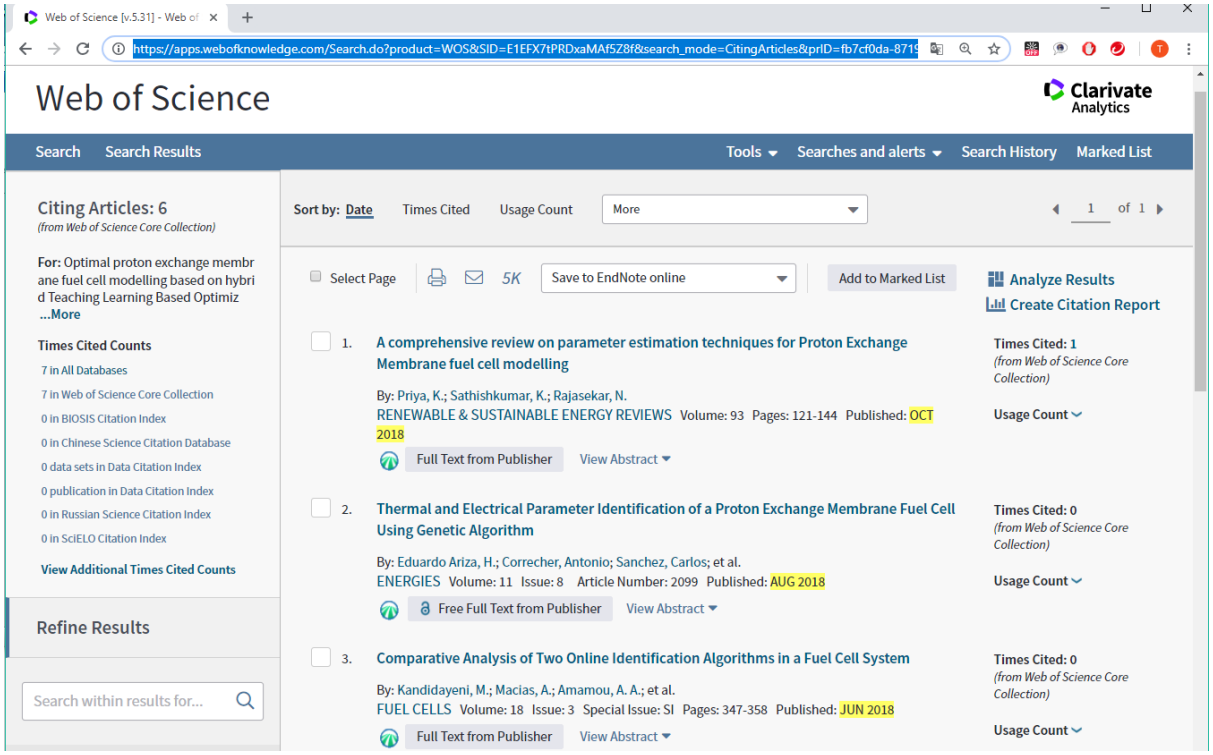

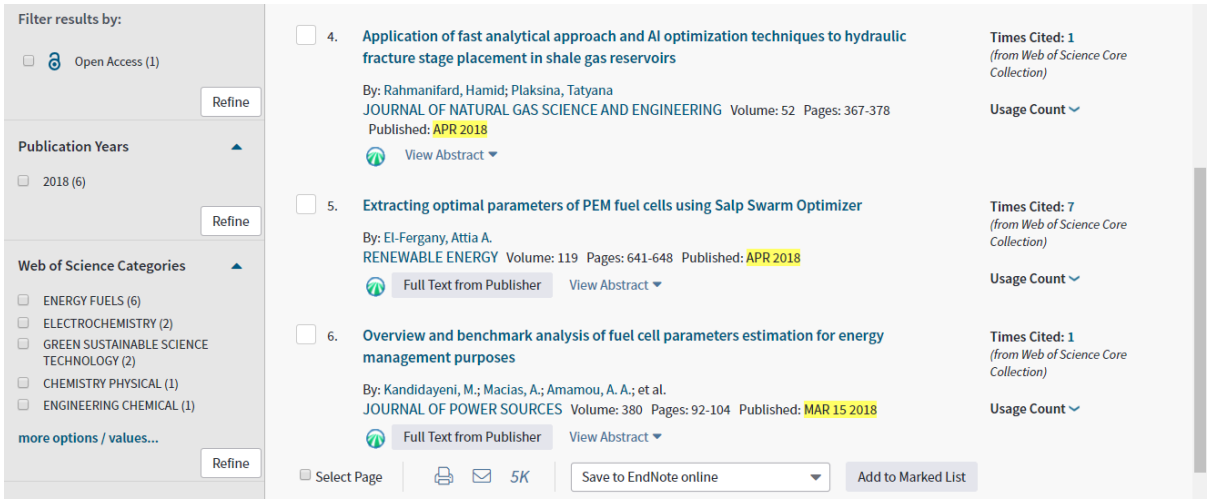

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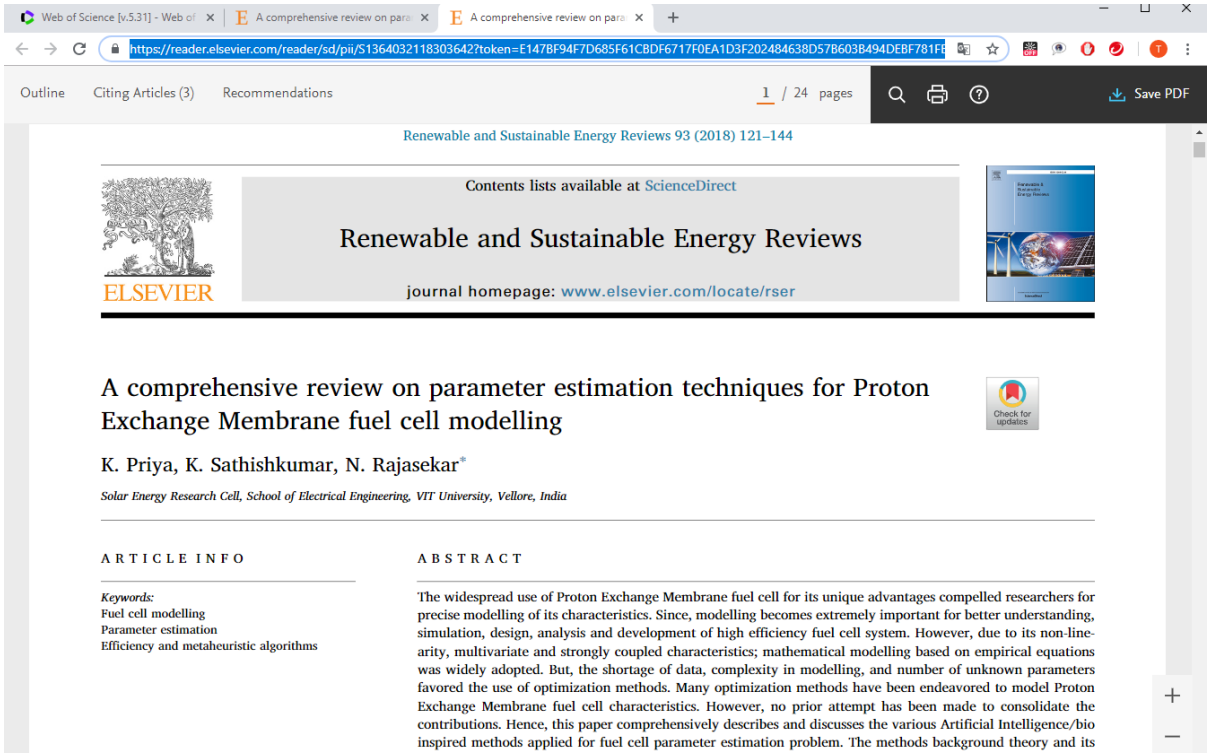

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A comprehensive review on parameter estimation techniques for Proton Exchange Membrane fuel cell modelling

K. Priya, K. Sathishkumar, N. Rajasekar*

Solar Energy Research Cell, School of Electrical Engineering, VIT University, Vellore, India

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ABSTRACT

The widespread use of Proton Exchange Membrane fuel cell for its unique advantages compelled researchers for precise modelling of its characteristics. Since, modelling becomes extremely important for better understanding, simulation, design, analysis and development of high efficiency fuel cell system. However, due to its non-linearity, multivariate and strongly coupled characteristics; mathematical modelling based on empirical equations was widely adopted. But, the shortage of data, complexity in modelling, and number of unknown parameters favored the use of optimization methods. Many optimization methods have been endeavored to model Proton Exchange Membrane fuel cell characteristics. However, no prior attempt has been made to consolidate the contributions. Hence, this paper comprehensively describes and discusses the various Artificial Intelligence/bio inspired methods applied for fuel cell parameter estimation problem. The methods background theory and its

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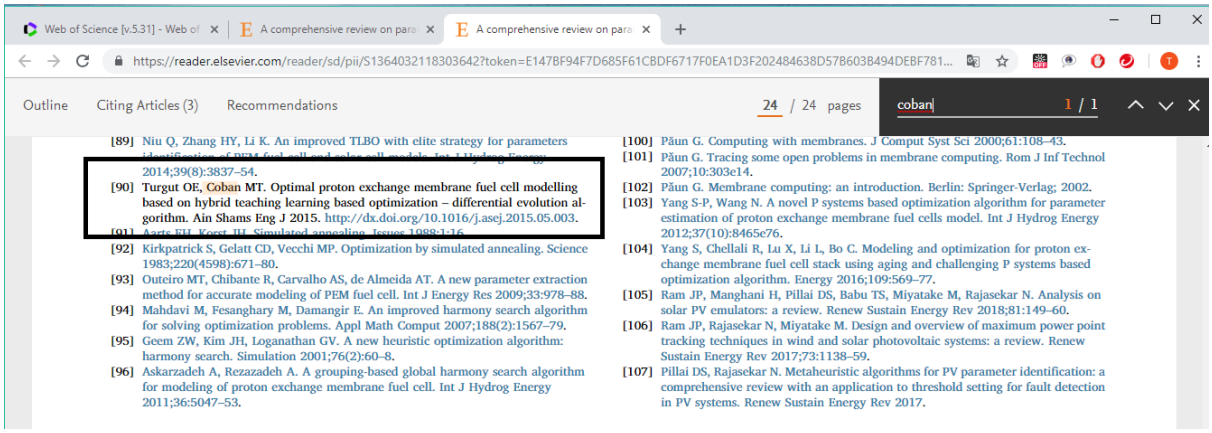

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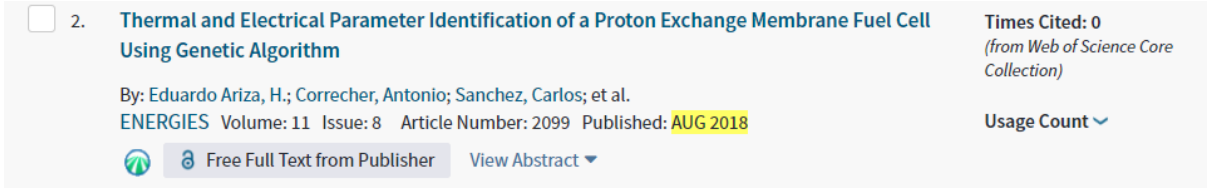

2. **Thermal and Electrical Parameter Identification of a Proton Exchange Membrane Fuel Cell Using Genetic Algorithm**

By: Eduardo Ariza, H.; Correcher, Antonio; Sanchez, Carlos; et al.
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Thermal and Electrical Parameter Identification of a Proton Exchange Membrane Fuel Cell Using Genetic Algorithm

H. Eduardo Ariza [1,*], Antonio Correcher [2], Carlos Sánchez [3], Ángel Pérez-Navarro [3] and Emilio García [2]

[1] Grupo de Investigación en Sistemas Inteligentes, Corporación Universitaria Comfacauca, Popayán CP 190003, Colombia
[2] Instituto De Automática E Informática Industrial-ai2, Universitat Politècnica de València, Valencia 46022, Spain; ancorsal@upv.es (A.C.); egarciam@isa.upv.es (E.G.)
[3] Instituto Universitario de Ingeniería Energética—IUIIE, Universitat Politècnica de València, Valencia 46022, Spain; csanched@eln.upv.es (C.S.); anavarro@iie.upv.es (Á.P.-N.)
* Correspondence: helarcha@posgrado.upv.es; Tel.: +57-2838-6000

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Abstract: Proton Exchange Membrane Fuel Cell (PEMFC) fuel cells is a technology successfully used in the production of energy from hydrogen, allowing the use of hydrogen as an energy vector. It is scalable for stationary and mobile applications. However, the technology demands more research. An important research topic is fault diagnosis and condition monitoring to improve the life and the efficiency and to reduce the operation costs of PEMFC devices. Consequently, there is a need of physical models that allow deep analysis. These models must be accurate enough to represent the PEMFC behavior and to allow the identification of different internal signals of a PEM fuel cell. This work presents a PEM fuel cell model that uses the output temperature in a closed loop, so it can represent the thermal and the electrical behavior. The model is used to represent a Nexa Ballard 1.2 kW fuel cell; therefore, it is necessary to fit the coefficients to represent the real behavior. Five optimization algorithms were tested to fit the model, three of them taken from literature and two proposed in this work. Finally, the model with the identified parameters was validated with real data.

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Citation 3:

3. **Comparative Analysis of Two Online Identification Algorithms in a Fuel Cell System**

By: Kandidayeni, M.; Macias, A.; Amamou, A. A.; et al.

FUEL CELLS Volume: 18 Issue: 3 Special Issue: SI Pages: 347-358 Published: JUN 2018

Full Text from Publisher View Abstract

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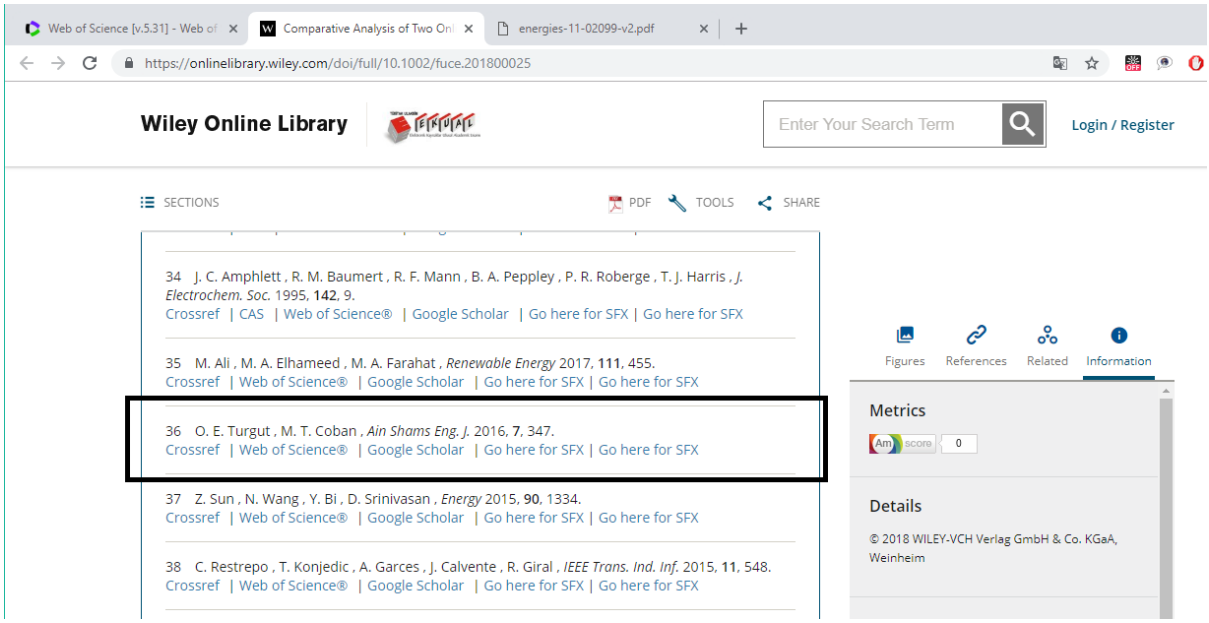

Citation 4:

Application of Fast Analytical Approach and AI Optimization Techniques to Hydraulic Fracture Stage Placement in Shale Gas Reservoirs

Hamid Rahmanifard, Tatyana Plaksina[1]

Department of Chemical and Petroleum Engineering, Schulich of Engineering, University of Calgary, 2500 University Dr. NW, Calgary, Alberta, Canada, T2N 1N4

Abstract

In the last decades, natural gas from unconventional reservoirs has become a major portion of total gas supply due to advances in horizontal well drilling and multi-stage hydraulic fracturing as well as reduction of operational costs and capital expenditures. However, hydraulic fracturing technique is a still costly and resource intensive production strategy that requires optimal planning to conform to the best safety practices and to obtain the highest returns on investments.

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Wilson, K., & Durlofsky, L. J. (2012). *Computational optimization of shale resource*

Citation 5:

5. **Extracting optimal parameters of PEM fuel cells using Salp Swarm Optimizer**

By: El-Fergany, Attia A.

RENEWABLE ENERGY Volume: 119 Pages: 641-648 Published: APR 2018

Full Text from Publisher View Abstract

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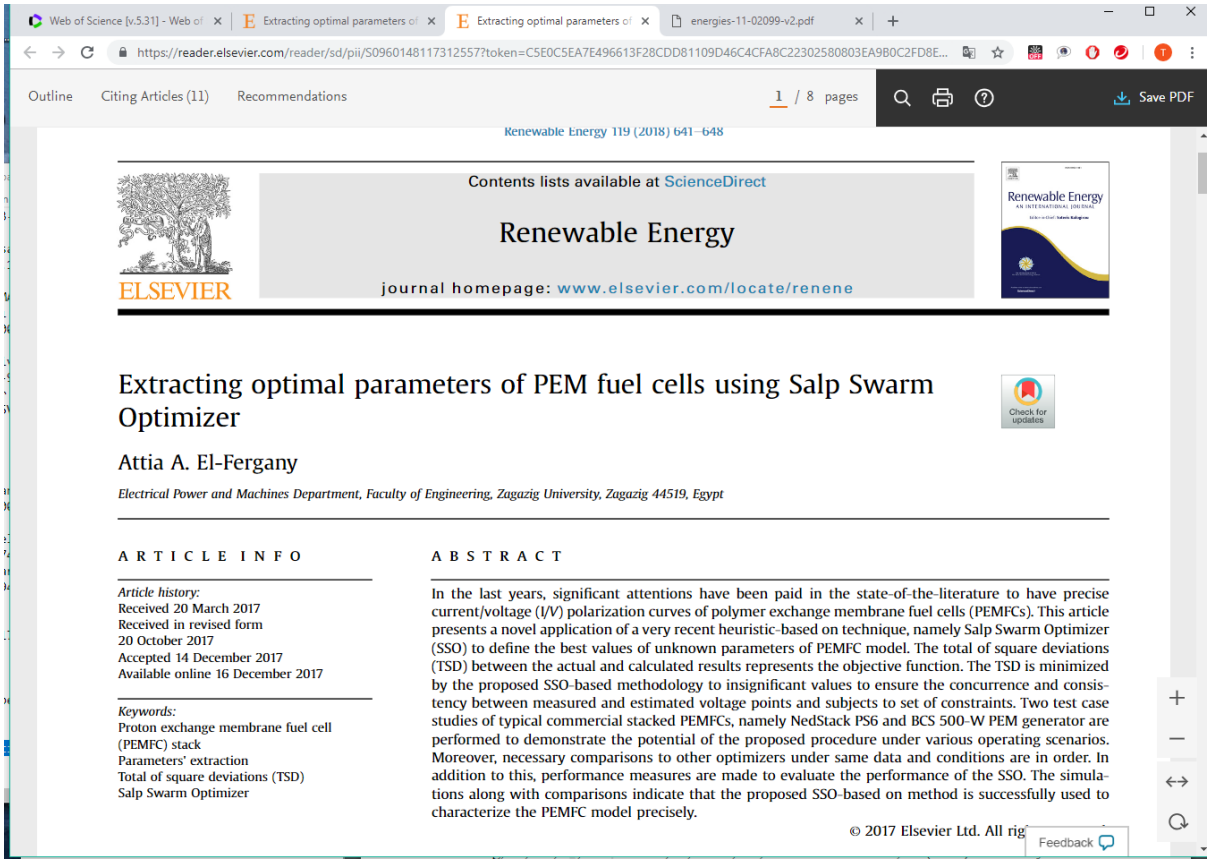

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Extracting optimal parameters of PEM fuel cells using Salp Swarm Optimizer

Attia A. El-Fergany

Electrical Power and Machines Department, Faculty of Engineering, Zagazig University, Zagazig 44519, Egypt

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ABSTRACT

In the last years, significant attentions have been paid in the state-of-the-literature to have precise current/voltage (*I/V*) polarization curves of polymer exchange membrane fuel cells (PEMFCs). This article presents a novel application of a very recent heuristic-based on technique, namely Salp Swarm Optimizer (SSO) to define the best values of unknown parameters of PEMFC model. The total of square deviations (TSD) between the actual and calculated results represents the objective function. The TSD is minimized by the proposed SSO-based methodology to insignificant values to ensure the concurrence and consistency between measured and estimated voltage points and subjects to set of constraints. Two test case studies of typical commercial stacked PEMFCs, namely NedStack PS6 and BCS 500-W PEM generator are performed to demonstrate the potential of the proposed procedure under various operating scenarios. Moreover, necessary comparisons to other optimizers under same data and conditions are in order. In addition to this, performance measures are made to evaluate the performance of the SSO. The simulations along with comparisons indicate that the proposed SSO-based on method is successfully used to characterize the PEMFC model precisely.

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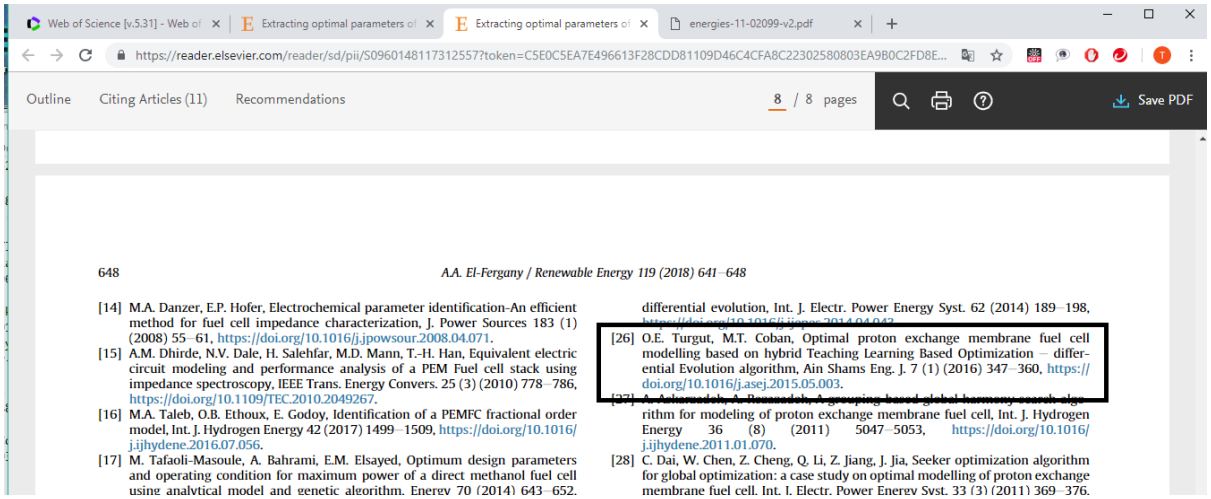

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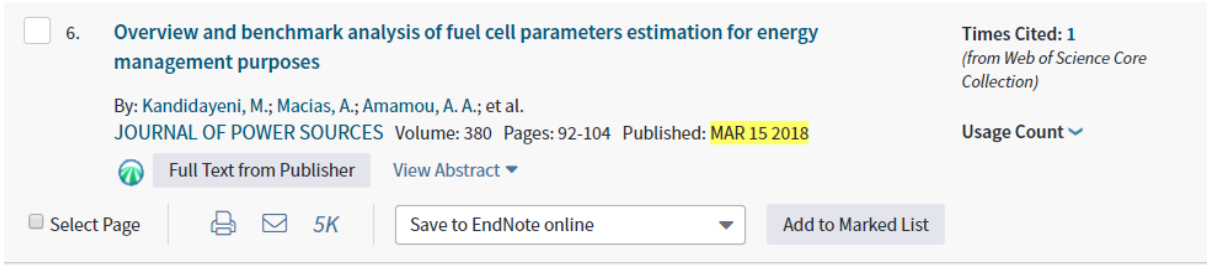

6. Overview and benchmark analysis of fuel cell parameters estimation for energy management purposes

By: Kandidayeni, M.; Macias, A.; Amamou, A. A.; et al.
JOURNAL OF POWER SOURCES Volume: 380 Pages: 92-104 Published: MAR 15 2018

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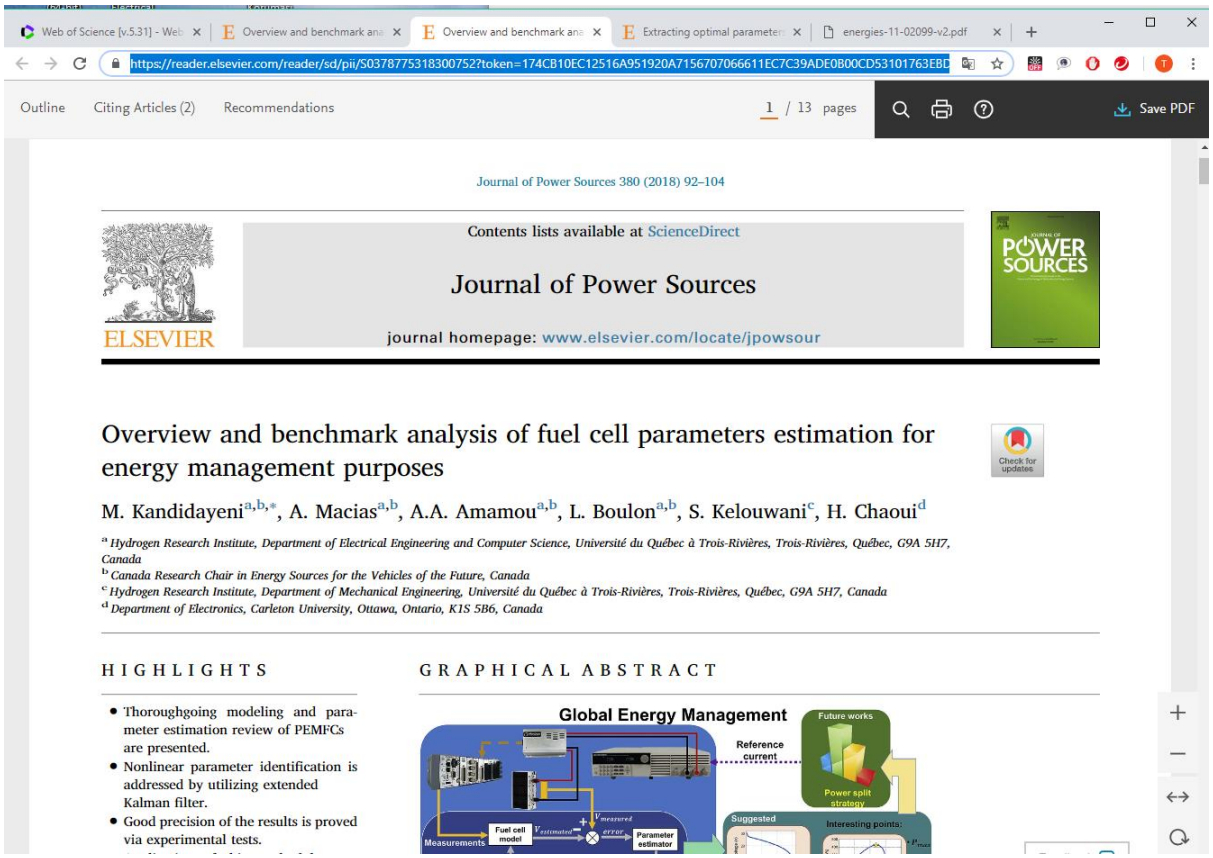

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Journal of Power Sources 380 (2018) 92–104

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Overview and benchmark analysis of fuel cell parameters estimation for energy management purposes

M. Kandidayeni[a,b,*], A. Macias[a,b], A.A. Amamou[a,b], L. Boulon[a,b], S. Kelouwani[c], H. Chaoui[d]

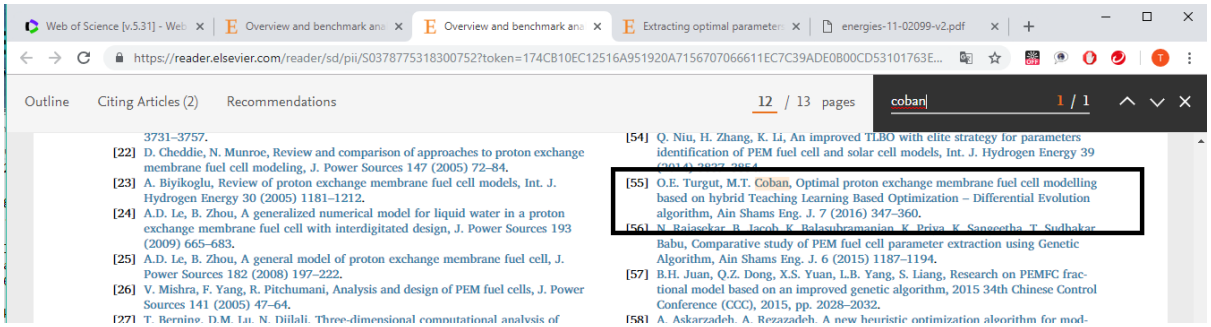
[a] Hydrogen Research Institute, Department of Electrical Engineering and Computer Science, Université du Québec à Trois-Rivières, Trois-Rivières, Québec, G9A 5H7, Canada
[b] Canada Research Chair in Energy Sources for the Vehicles of the Future, Canada
[c] Hydrogen Research Institute, Department of Mechanical Engineering, Université du Québec à Trois-Rivières, Trois-Rivières, Québec, G9A 5H7, Canada
[d] Department of Electronics, Carleton University, Ottawa, Ontario, K1S 5B6, Canada

HIGHLIGHTS

- Thoroughgoing modeling and parameter estimation review of PEMFCs are presented.
- Nonlinear parameter identification is addressed by utilizing extended Kalman filter.
- Good precision of the results is proved via experimental tests.

GRAPHICAL ABSTRACT

Reference 55



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