



algorithms (</journal/algorithms>)

Title / Keyword	
Author / Affiliation	
Article Type	all
Journal	Algorithms
Section	--
Special Issue	all

[Advanced \(/search?advanced&journal=algorithms\)](/search?advanced&journal=algorithms)

[Advanced \(/search?](/search?advanced&journal=algorithms)

Search

[advanced&journal=algorithms\)](/search?advanced&journal=algorithms)



(<http://ip-science.thomsonreuters.com/cgi-bin/jrnlst/jlresults.cgi?PC=MASTER&ISSN=1999-4893>)



[Volume 10, Issue 2 \(/1999-4893/10/2\)](/1999-4893/10/2)

► [Article Menu](#)

Views

711

Downloads

480

Citations

2

([https://www.altmetric.com/details.php?](https://www.altmetric.com/details.php?domain=www.mdpi.com&doi=10.3390%2Fa10020068)
domain=www.mdpi.com&doi=10.3390%2Fa10020068)

Article Versions

- [Abstract \(/1999-4893/10/2/68\)](/1999-4893/10/2/68)
- [Full-Text PDF \(/1999-4893/10/2/68/pdf\)](/1999-4893/10/2/68/pdf) [660 KB]

- [Full-Text HTML \(/1999-4893/10/2/68/htm\)](#)
- [Full-Text XML](#)
- [Full-Text Epub \(/1999-4893/10/2/68/epub\)](#)
- [Article Versions Notes \(/1999-4893/10/2/68/notes\)](#)

Related Info

- [Google Scholar \(http://scholar.google.com/scholar?q=An Easily Understandable Grey Wolf Optimizer and Its Application to Fuzzy Controller Tuning\)](http://scholar.google.com/scholar?q=An+Easily+Understandable+Grey+Wolf+Optimizer+and+Its+Application+to+Fuzzy+Controller+Tuning)
- [Order Reprints \(/1999-4893/10/2/68/reprints\)](#)

More by Authors

- on DOAJ
- on Google Scholar
- on PubMed

Export Article

- BibTeX
- EndNote
- RIS



(mailto:?)

[&subject=From%20MDPI%3A%20%22An%20Easily%20Understandable%20Grey%20Wolf%20Optimizer%20and%20Its%20Application%204893%2F10%2F2%2F68%3A%0A%0AAAn%20Easily%20Understandable%20Grey%20Wolf%20Optimizer%20and%20Its%20Application%20Sugeno%20proportional-integral%20fuzzy%20controllers%20%28T-S%20PI-](#)

FCs%29.%20GWO%20is%20employed%20for%20solving%20optimization%20problems%20focused%20on%20the%20minimization%20time%20objective%20functions%20defined%20as%20the%20weighted%20sum%20of%20the%20absolute%20value%20of%20the%20cc
S%20PI-

FCs. Since the sensitivity functions are introduced with respect to the parametric variations of the fuzzy controller tuning approach. GWO algorithms applied with this regard are formulated



[...] (<http://twitter.com/home?>

[status=%23mdpialgorithms+An+Easily+Understandable+Grey+Wolf+Optimizer+and+Its+Application+to+Fuzzy+Controller+Tuning+http%3](#)

4893%2F10%2F2%2F68++%40MDPIOpenAccess) (<http://www.linkedin.com/shareArticle?>

mini=true&url=http%3A%2F%2Fwww.mdpi.com%2F1999-

[4893%2F10%2F2%2F68&title=An%20Easily%20Understandable%20Grey%20Wolf%20Optimizer%20and%20Its%20Application%20to%20Sugeno%20proportional-integral%20fuzzy%20controllers%20%28T-S%20PI-](#)



FCs%29.%20GWO%20is%20employed%20for%20solving%20optimization%20problems%20focused%20%5B...%5D)

(<http://www.facebook.com/sharer.php?u=http://www.mdpi.com/1999-4893/10/2/68>)



(http://serve.mdpi.com/www/my_files/cliik.php?oaparams=0bannerid=1537zoneid=4cb=6)

Algorithms **2017**, *10*(2), 68; doi:10.3390/a10020068 (<http://dx.doi.org/10.3390/a10020068>)

Open Access Article

An Easily Understandable Grey Wolf Optimizer and Its Application to Fuzzy Controller Tuning

Radu-Emil Precup (/search?authors=Radu-Emil%20Precup&orcid=)^{1,*}  (mailto:please login),

Radu-Codrut David (</search?authors=Radu-Codrut%20David&orcid=>)¹ ([mailto:please login](mailto:please_login)).

Alexandra-Iulia Szedlak-Stinean ([/search?authors=Alexandra-Iulia%20Szedlak-Stinean&orcid=](#))¹

(mailto:please_login).

- ¹ Department of Automation and Applied Informatics, Politehnica University of Timisoara, Bd. V. Parvan 2, 300223 Timisoara, Romania
- ² School of Electrical Engineering and Computer Science, University of Ottawa, 800 King Edward, Ottawa, ON K1N 6N5 Canada
- * Author to whom correspondence should be addressed.

Academic Editor: Oscar Castillo

Received: 25 April 2017 / Revised: 7 June 2017 / Accepted: 8 June 2017 / Published: 10 June 2017

(This article belongs to the Special Issue [Extensions to Type-1 Fuzzy Logic: Theory, Algorithms and Applications](/journal/algorithms/special_issues/fuzzy_logic) (/journal/algorithms/special_issues/fuzzy_logic))

[View Full-Text \(/1999-4893/10/2/68/htm\)](/1999-4893/10/2/68/htm) | [Download PDF \(/1999-4893/10/2/68/pdf\)](/1999-4893/10/2/68/pdf) [660 KB, uploaded 13 June 2017]
 | [Browse Figures \(/algorithms/algorithms-10-00068/article_deploy/html/images/algorithms-10-00068-g001.png\)](/algorithms/algorithms-10-00068/article_deploy/html/images/algorithms-10-00068-g001.png)
[\(/algorithms/algorithms-10-00068/article_deploy/html/images/algorithms-10-00068-g002.png\)](/algorithms/algorithms-10-00068/article_deploy/html/images/algorithms-10-00068-g002.png)

Abstract

This paper proposes an easily understandable Grey Wolf Optimizer (GWO) applied to the optimal tuning of the parameters of Takagi-Sugeno proportional-integral fuzzy controllers (T-S PI-FCs). GWO is employed for solving optimization problems focused on the minimization of discrete-time objective functions defined as the weighted sum of the absolute value of the control error and of the squared output sensitivity function, and the vector variable consists of the tuning parameters of the T-S PI-FCs. Since the sensitivity functions are introduced with respect to the parametric variations of the process, solving these optimization problems is important as it leads to fuzzy control systems with a reduced process parametric sensitivity obtained by a GWO-based fuzzy controller tuning approach. GWO algorithms applied with this regard are formulated in easily understandable terms for both vector and scalar operations, and discussions on stability, convergence, and parameter settings are offered. The controlled processes referred to in the course of this paper belong to a family of nonlinear servo systems, which are modeled by second order dynamics plus a saturation and dead zone static nonlinearity. Experimental results concerning the angular position control of a laboratory servo system are included for validating the proposed method. [View Full-Text \(/1999-4893/10/2/68/htm\)](/1999-4893/10/2/68/htm)

Keywords: [Grey Wolf Optimizer \(/search?q=Grey Wolf Optimizer\)](/search?q=Grey+Wolf+Optimizer); [Takagi-Sugeno proportional-integral fuzzy controllers \(/search?q=Takagi-Sugeno proportional-integral fuzzy controllers\)](/search?q=Takagi-Sugeno+proportional-integral+fuzzy+controllers); [process parametric sensitivity \(/search?q=process parametric sensitivity\)](/search?q=process+parametric+sensitivity); [stability \(/search?q=stability\)](/search?q=stability); [convergence \(/search?q=convergence\)](/search?q=convergence); [parameter settings \(/search?q=parameter settings\)](/search?q=parameter+settings); [angular position \(/search?q=angular position\)](/search?q=angular+position)

▼ Figures

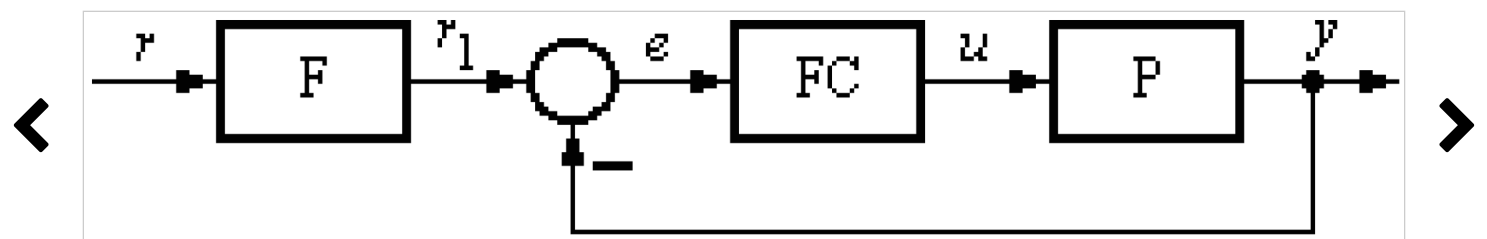


Figure 1

(/algorithms/algorithms-10-00068/article_deploy/html/images/algorithms-10-00068-g001.png) (/algorithms/algorithms-10-00068/article_deploy/html/images/algorithms-10-00068-g002.png)

This is an open access article distributed under the [Creative Commons Attribution License](https://creativecommons.org/licenses/by/4.0/) (<https://creativecommons.org/licenses/by/4.0/>) which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. (CC BY 4.0).

Scifed alert for new publications

Never miss any articles matching your research **from any publisher**

- Get alerts for new papers matching your research
- Find out the new papers from selected authors
- Updated daily for 49'000+ journals and 6000+ publishers

Define your Scifed now



Never Miss Any Articles
Matching Your Research
from Any Publisher

- Get alerts for new papers matching your research
- Find out the new papers from selected authors
- Updated daily for 49'000+ journals and 6000+ publishers



Share & Cite This Article



(mailto:?)

&subject=From%20MDPI%3A%20%22An%20Easily%20Understandable%20Grey%20Wolf%20Optimizer%20and%20Its%20Appl
Sugeno%20proportional-integral%20fuzzy%20controllers%20%28T-S%20PI-

FCs%29.%20GWO%20is%20employed%20for%20solving%20optimization%20problems%20focused%20on%20the%20minimiza
time%20objective%20functions%20defined%20as%20the%20weighted%20sum%20of%20the%20absolute%20value%20of%20th
S%20PI-

FCs.%20Since%20the%20sensitivity%20functions%20are%20introduced%20with%20respect%20to%20the%20parametric%20va
based%20fuzzy%20controller%20tuning%20approach.%20GWO%20algorithms%20applied%20with%20this%20regard%20are%20



(http://twitter.com/home?

status=%23mdpi%20algorithms%20An%20Easily%20Understandable%20Grey%20Wolf%20Optimizer%20and%20Its%20Application%20to%20Fuzzy%20Controller%20Tuning



(http://www.linkedin.com/shareArticle?

mini=true&url=http%3A%2F%2Fwww.mdpi.com%2F202214&title=An%20Easily%20Understandable%20Grey%20Wolf%20Optimi
Sugeno%20proportional-integral%20fuzzy%20controllers%20%28T-S%20PI-

FCs%29.%20GWO%20is%20employed%20for%20solving%20optimization%20problems%20focused%20on%20the%20minimiza
time%20objective%20functions%20defined%20as%20the%20weighted%20sum%20of%20the%20absolute%20value%20of%20th
S%20PI-



(http://www.facebook.com/sharer.php?u=http://www.mdpi.com/202214)  (https://plus.google.com/share?

url=http://www.mdpi.com/202214)  (http://www.reddit.com/submit?url=http://www.mdpi.com/202214)

(http://www.mendeley.com/import/?url=http://www.mdpi.com/202214)

(http://www.citeulike.org/posturl?

url=http://www.mdpi.com/202214)

MDPI and ACS Style

Precup, R.-E.; David, R.-C.; Szedlak-Stinean, A.-I.; Petriu, E.M.; Dragan, F. An Easily Understandable Grey Wolf Optimizer and Its Application to Fuzzy Controller Tuning. *Algorithms* **2017**, *10*, 68.

[Show more citation formats](#)

Related Articles

A Novel Remaining Useful Life Prediction Approach for Superbuck Converter Circuits Based on Modified Grey Wolf Optimizer-Support Vector Regression

Li Wang, *Energies*

A Novel Complex-Valued Encoding Grey Wolf Optimization Algorithm

Luo, Qifang ; Zhang, Sen ; Li, Zhiming ; Zhou, Yongquan et al., *Algorithms*

Simultaneous Robust Coordinated Damping Control of Power System Stabilizers (PSSs), Static Var Compensator (SVC) and Doubly-Fed Induction Generator Power Oscillation Dampers (DFIG PODs) in Multimachine Power Systems

Zuo, Jian ; Li, Yinhong ; Shi, Dongyuan ; Duan, Xianzhong et al., *Energies*

Robust Longitudinal Speed Control of Hybrid Electric Vehicles with a Two-Degree-of-Freedom Fuzzy Logic Controller

Jau-Woei Perng, *Energies*

Equivalence between Fuzzy PID Controllers and Conventional PID Controllers

Chao, Chun-Tang ; Sutarna, Nana ; Chiou, Juing-Shian ; Wang, Chi-Jo et al., *Appl Sci*

An efficient parallel processing optimal control scheme for a class of nonlinear composite systems

A., *Acta Mathematica Scientia*

Increased functional connectivity common to symptomatic amyotrophic lateral sclerosis and those at genetic risk

Ricarda A L Menke et al., *J Neurol Neurosurg Psychiatry*

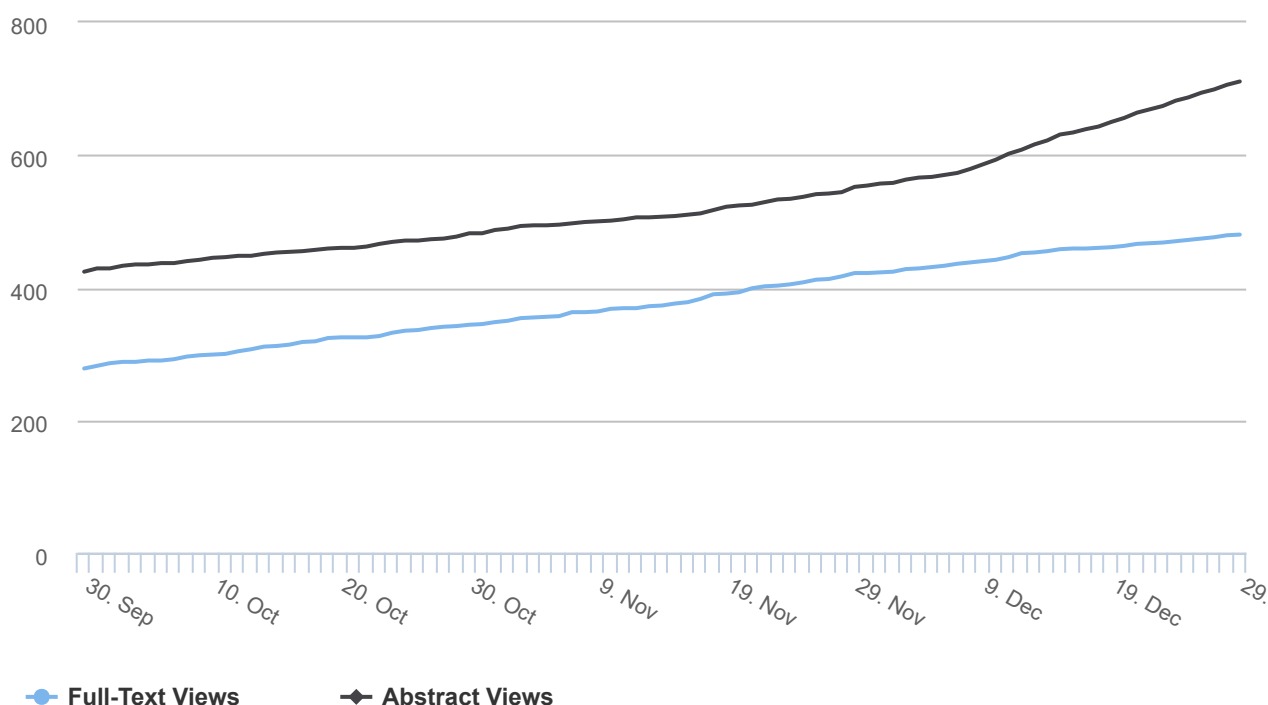
Time-based reflow soldering optimization by using adaptive Kriging-HDMR method

Liming Chen, *Soldering & Surface Mount Technology*

Powered by

Article Metrics

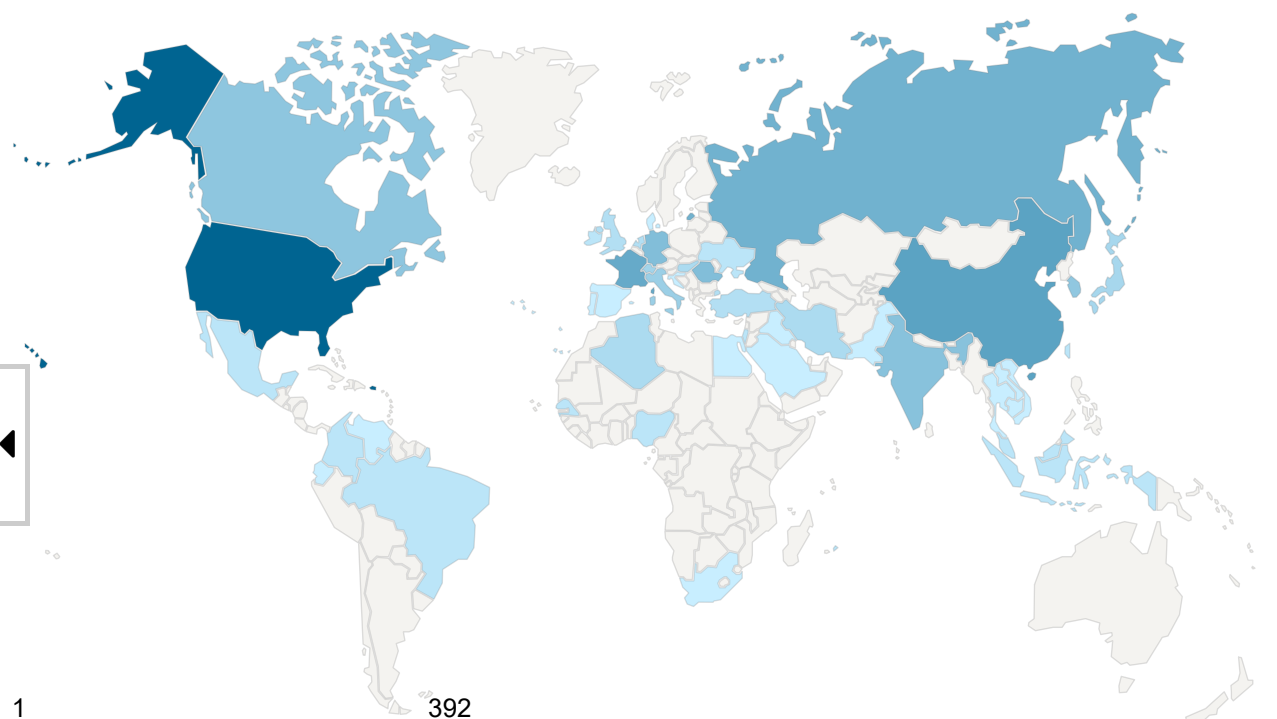
Article access statistics



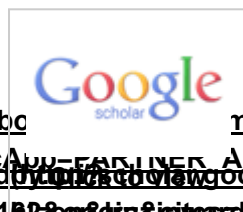
For more information on the journal statistics, click [here](http://journal/algorithms/stats) ([/journal/algorithms/stats](http://journal/algorithms/stats)). Multiple requests from the same IP address are counted as one view.

Article Access Statistics

[Abstract views](#) [Pdf views](#) [Html views](#)



Citations



([\(http://gateway.webc...n/gateway/Gateway.cgi?GWVersion=2&SrcAuth=LINKS&SrcAuth=LinksAMR&KeyUT=WO:](http://gateway.webc...n/gateway/Gateway.cgi?GWVersion=2&SrcAuth=LINKS&SrcAuth=LinksAMR&KeyUT=WO:)
([https://www.scopus.com/inward/citedbyurl.do?linking=google.com/scholar?](https://www.scopus.com/inward/citedbyurl.do?linking=google.com/scholar?partnerID=HzOxMe3b&scp=8502068311229&in&site=sh)
<http://dx.doi.org/10.3390/a10020068>)

[\[Return to top\]](#)

Submit to *Algorithms* ([http://susy.mdpi.com/user/manuscripts/upload?form\[journal_id\]=13](http://susy.mdpi.com/user/manuscripts/upload?form[journal_id]=13))

Review for *Algorithms* (<https://susy.mdpi.com/volunteer/journals/review>)

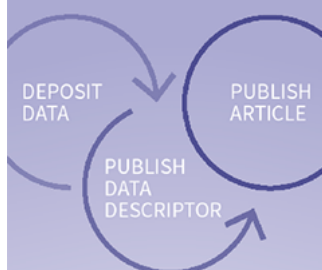
[Edit a Special Issue \(/journalproposal/sendproposalspecialissue/algorithms\)](/journalproposal/sendproposalspecialissue/algorithms)

PUBLISH YOUR
DATA SET
IN OUR OPEN ACCESS
JOURNAL



data

AND ENHANCE
ITS VISIBILITY



[Algorithms \(/journal/algorithms\)](/journal/algorithms)

EISSN 1999-4893

Published by MDPI AG, Basel, Switzerland

[RSS \(/rss/journal/algorithms\)](/rss/journal/algorithms)

[E-Mail Table of Contents Alert \(/journal/algorithms/toc-alert\)](/journal/algorithms/toc-alert)

Further Information

[Article Processing Charges \(/about/apc\)](/about/apc)

[Pay an Invoice \(https://payment.mdpi.com\)](https://payment.mdpi.com)

[Open Access Policy \(/about/openaccess\)](/about/openaccess)

[Terms of Use \(/about/termsofuse\)](/about/termsofuse)

[Terms and Conditions \(/about/terms-and-conditions\)](/about/terms-and-conditions)

[Privacy Policy \(/about/privacy\)](/about/privacy)

[Contact MDPI \(/about/contact\)](/about/contact)

[Jobs at MDPI \(/about/jobs\)](/about/jobs)

Guidelines

[For Authors \(/authors\)](/authors)

[For Reviewers \(/reviewers\)](/reviewers)

[For Editors \(/editors\)](/editors)

[For Librarians \(/librarians\)](/librarians)

[For Publishers \(/publishing_services\)](/publishing_services)
[For Societies \(/societies\)](/societies)

MDPI Initiatives

[Institutional Open Access Program \(IOAP\) \(/about/ioap\)](/about/ioap)
[Sciforum \(http://sciforum.net\)](http://sciforum.net)
[Preprints \(http://preprints.org\)](http://preprints.org)
[Scilit \(http://www.scilit.net\)](http://www.scilit.net)
[MDPI Books \(http://mdpi.com/books\)](http://mdpi.com/books)
[MDPI Blog \(http://blog.mdpi.com/\)](http://blog.mdpi.com/)

Follow MDPI

[LinkedIn \(https://www.linkedin.com/company/mdpi\)](https://www.linkedin.com/company/mdpi)
[Facebook \(https://www.facebook.com/MDPIOpenAccessPublishing\)](https://www.facebook.com/MDPIOpenAccessPublishing)
[Twitter \(https://twitter.com/MDPIOpenAccess\)](https://twitter.com/MDPIOpenAccess)
[Google+ \(https://plus.google.com/+MdpiOA/posts\)](https://plus.google.com/+MdpiOA/posts)

Subscribe to receive issue release notifications and newsletters from MDPI journals

Select Journal/Journals:

Select options

Your email address here...

Subscribe