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## A comparative study of clonal selection algorithm for effluent removal forecasting in septic sludge treatment plant (Article)

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### Abstract

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The development of effluent removal prediction is crucial in providing a planning tool necessary for the future development and the construction of a septic sludge treatment plant (SSTP), especially in the developing countries. In order to investigate the expected functionality of the required standard, the prediction of the effluent quality, namely biological oxygen demand, chemical oxygen demand and total suspended solid of an SSTP was modelled using an artificial intelligence approach. In this paper, we adopt the clonal selection algorithm (CSA) to set up a prediction model, with a well-established method - namely the least-square support vector machine (LS-SVM) as a baseline model. The test results of the case study showed that the prediction of the CSA-based SSTP model worked well and provided model performance as satisfactory as the LS-SVM model. The CSA approach shows that fewer control and training parameters are required for model simulation as compared with the LS-SVM approach. The ability of a CSA approach in resolving limited data samples, nonlinear sample function and multidimensional pattern recognition makes it a powerful tool in modelling the prediction of effluent removals in an SSTP. © IWA Publishing 2015.

### Author keywords

Biological oxygen demand   Chemical oxygen demand   Clonal selection algorithm   Leastsquare support vector machine  
Septic sludge treatment plant   Total suspended solids

### Indexed keywords

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(2012) *Proceedings - 2012 International Conference on Computer Distributed Control*

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 (2006) *Journal of Applied Sciences*

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## References (32)

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- 1 Belanche, L., Valdés, J.J., Comas, J., Roda, I.R., Poch, M.  
 Prediction of the bulking phenomenon in wastewater treatment plants

(2000) *Artificial Intelligence in Engineering*, 14 (4), pp. 307-317. Cited 54 times.  
 doi: 10.1016/S0954-1810(00)00012-1

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- 2 Burges, C.J.C.  
 A tutorial on support vector machines for pattern recognition

(1998) *Data Mining and Knowledge Discovery*, 2 (2), pp. 121-167. Cited 9521 times.


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- 
- 3 Ribeiro, D., Sanfins, A., Belo, O.  
**Wastewater treatment plant performance prediction with support vector machines**  
  
(2013) *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, 7987 LNAI, pp. 99-111. Cited 2 times.  
ISBN: 978-364239735-6  
doi: 10.1007/978-3-642-39736-3\_8  
  
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- 
- 4 Dasgupta, D.  
**Advances in artificial immune systems**  
  
(2006) *IEEE Computational Intelligence Magazine*, 1 (4), pp. 40-43. Cited 365 times.  
doi: 10.1109/CI-M.2006.248056  
  
View at Publisher
- 
- 5 Du, H., Shao, H., Yao, P.  
**Adaptive neural network control for a class of low-triangular-structured nonlinear systems**  
  
(2006) *IEEE Transactions on Neural Networks*, 17 (2), pp. 509-514. Cited 112 times.  
doi: 10.1109/TNN.2005.863403  
  
View at Publisher
- 
- 6 Elmolla, E.S., Chaudhuri, M., Eltoukhy, M.M.  
**The use of artificial neural network (ANN) for modeling of COD removal from antibiotic aqueous solution by the Fenton process**  
  
(2010) *Journal of Hazardous Materials*, 179 (1-3), pp. 127-134. Cited 106 times.  
doi: 10.1016/j.jhazmat.2010.02.068  
  
View at Publisher
- 
- 7 Engin, O., Döyen, A.  
**A new approach to solve hybrid flow shop scheduling problems by artificial immune system**  
  
(2004) *Future Generation Computer Systems*, 20 (6 SPEC. ISS.), pp. 1083-1095. Cited 185 times.  
doi: 10.1016/j.future.2004.03.014  
  
View at Publisher
- 
- 8 EPA (Environment Protection Authority)  
(2007) *Regulatory Monitoring and Testing Water and Wastewater Sampling*  
EPA, Adelaide, Australia  
[http://www.epa.sa.gov.au/xstd\\_files/Water/Guideline/guide\\_wws.pdf](http://www.epa.sa.gov.au/xstd_files/Water/Guideline/guide_wws.pdf)
- 
- 9 Greensmith, J., Whitbrook, A., Aickelin, U.  
(2010) *Handbook of Metaheuristics. 2<sup>nd</sup> Edn*, pp. 421-448.  
Chapter 14 (Artificial Immune Systems), Kluwer Academic, Norwell, MA, USA
- 
- 10 Gujer, W., Henze, M., Mino, T., Van Loosdrecht, M.  
**Activated Sludge Model No. 3**  
  
(1999) *Water Science and Technology*, 39 (1), pp. 183-193. Cited 575 times.  
doi: 10.1016/S0273-1223(98)00785-9  
  
View at Publisher
-

- 
- 11 Hamoda, M.F., Al-Ghusain, I.A., Hassan, A.H.  
**Integrated wastewater treatment plant performance evaluation using artificial neural networks**  
  
(1999) *Water Science and Technology*, 40 (7), pp. 55-65. Cited 52 times.  
doi: 10.1016/S0273-1223(99)00584-3  
  
View at Publisher
- 
- 12 Hanbay, D., Turkoglu, I., Demir, Y.  
**Prediction of wastewater treatment plant performance based on wavelet packet decomposition and neural networks**  
  
(2008) *Expert Systems with Applications*, 34 (2), pp. 1038-1043. Cited 56 times.  
doi: 10.1016/j.eswa.2006.10.030  
  
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- 
- 13 Harremoës, P., Capodaglio, A.G., Hellstrom, B.G., Henze, M., Jensen, K.N., Lynggaard-Jensen, A., Otterpohl, R., (...), Soeberg, H.  
**Wastewater treatment plants under transient loading- Performance, modelling and control**  
  
(1993) *Water Science and Technology*, 27 (12), pp. 71-115. Cited 47 times.
- 
- 14 Henze, M., Grady, C.P.L., Gujer, W., Marais, G.R., Matsuo, T.  
**Activated Sludge Model No. 1**  
(1987) *IAWPRC Scientific and Technical Reports*. Cited 1092 times.  
IAWPRC, London
- 
- 15 Henze, M., Gujer, W., Mino, T., Matsuo, T., Wentzel, M.C., Marais, G.V.R.  
**Activated Sludge Model No. 2**  
(1995) *IAWPRC Scientific and Technical Reports*. Cited 399 times.  
IAWPRC, London
- 
- 16 Henze, M., Gujer, W., Mino, T., Matsuo, T., Wentzel, M.C., Marais, G.V.R., Van Loosdrecht, M.C.M.  
**Activated Sludge Model No.2d, ASM2d**  
  
(1999) *Water Science and Technology*, 39 (1), pp. 165-182. Cited 426 times.  
doi: 10.1016/S0273-1223(98)00829-4  
  
View at Publisher
- 
- 17 Hofmann, T., Schölkopf, B., Smola, A.J.  
**Kernel methods in machine learning**  
  
(2008) *Annals of Statistics*, 36 (3), pp. 1171-1220. Cited 432 times.  
[http://projecteuclid.org/DPubS/Repository/1.0/Disseminate?handle=euclid.aos/1211819561&view=body&content-type=pdfview\\_1](http://projecteuclid.org/DPubS/Repository/1.0/Disseminate?handle=euclid.aos/1211819561&view=body&content-type=pdfview_1)  
doi: 10.1214/009053607000000677  
  
View at Publisher
-

- 
- 18 Huang, Z., Luo, J., Li, X., Zhou, Y.  
Prediction of effluent parameters of wastewater treatment plant based on improved least square support vector machine with PSO  
  
(2009) *2009 1st International Conference on Information Science and Engineering, ICISE 2009*, art. no. 5454606, pp. 4058-4061. Cited 10 times.  
ISBN: 978-076953887-7  
doi: 10.1109/ICISE.2009.846  
  
View at Publisher
- 
- 19 Huang, M.-Z., Wan, J.-Q., Ma, Y.-W., Li, W.-J., Sun, X.-F., Wan, Y.  
A fast predicting neural fuzzy model for on-line estimation of nutrient dynamics in an anoxic/oxic process  
  
(2010) *Bioresource Technology*, 101 (6), pp. 1642-1651. Cited 29 times.  
<http://www.sciencedirect.com>  
doi: 10.1016/j.biortech.2009.08.111  
  
View at Publisher
- 
- 20 Irish Department of the Environment and Local Government  
(2001) *Urban Waste Water Treatment Regulations, 2001*  
S.I. No. 254/2001 accessed 18 November 2014  
<http://www.irishstatutebook.ie/2001/en/si/0254.html>
- 
- 21 Nowak, O., Franz, A., Svardal, K., Müller, V., Kühn, V.  
Parameter estimation for activated sludge models with the help of mass balances  
  
(1999) *Water Science and Technology*, 39 (4), pp. 113-120. Cited 58 times.  
doi: 10.1016/S0273-1223(99)00066-9  
  
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- 
- 22 Orth, H.  
Centralised versus decentralised wastewater systems?  
(2007) *Proceedings GWA Gewässerschutz-Wasser-Abwasser, Band 206, Advanced Sanitation Conference, International IWA Conference, 12-13 Mac, Aachen, Germany*, pp. 421-428.
- 
- 23 Petersen, B., Gernaey, K., Henze, M., Vanrolleghem, P.A.  
Evaluation of an ASM 1 model calibration procedure on municipal-industrial wastewater treatment plant  
(2002) *Journal of Hydroinformatics*, 4, pp. 15-38. Cited 86 times.
- 
- 24 Qiao, J.-F., Yang, W.-W., Yuan, M.-Z.  
Recurrent high order neural network modeling for wastewater treatment process  
  
(2011) *Journal of Computers*, 6 (8), pp. 1570-1577. Cited 2 times.  
<http://ojs.academypublisher.com/index.php/jcp/article/view/jcp060815701577/3401>  
doi: 10.4304/jcp.6.8.1570-1577  
  
View at Publisher
- 
- 25 Suykens, J.A.K., Vandewalle, J.  
Least squares support vector machine classifiers  
  
(1999) *Neural Processing Letters*, 9 (3), pp. 293-300. Cited 4217 times.  
  
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-

- 
- 26 Timmis, J.  
Artificial immune systems - Today and tomorrow  
  
(2007) *Natural Computing*, 6 (1), pp. 1-18. Cited 106 times.  
doi: 10.1007/s11047-006-9029-1  
  
[View at Publisher](#)
- 
- 27 Ting, S.C., Ismail, A.R., Malek, M.A.  
Bio-engineered solution in enhancement of septic sludge with artificial immune system  
(2012) *Proceedings of the 2<sup>nd</sup> International Conference on Water Resources (ICWR2012), 5-6November, 2012, Langkawi, Kedah*
- 
- 28 Ting, S.C., Ismail, A.R., Malek, M.A.  
Development of effluent removal prediction model efficiency in septic sludge treatment plant through clonal selection algorithm  
  
(2013) *Journal of Environmental Management*, 129, pp. 260-265. Cited 5 times.  
doi: 10.1016/j.jenvman.2013.07.022  
  
[View at Publisher](#)
- 
- 29 Chun, T.S., Malek, M.A., Ismail, A.R.  
Prediction analysis of effluent removal in a septic sludge treatment plant: A biomimetics engineering approach  
  
(2014) *Environmental Sciences: Processes and Impacts*, 16 (9), pp. 2208-2214. Cited 2 times.  
<http://www.rsc.org/publishing/journals/em/about.asp>  
doi: 10.1039/c4em00282b  
  
[View at Publisher](#)
- 
- 30 Wang, D.C.  
(2009) *Support Vector Machines Modeling Prediction and Control*. Cited 5 times.  
China Meteorological, Beijing
- 
- 31 Yang, B.-L., Zhao, D.-A., Jun, Z.  
Prediction system of sewage outflow COD based on LS-SVM  
  
(2011) *Proceedings of the 2nd International Conference on Intelligent Control and Information Processing, ICICIP 2011, (PART 1)*, art. no. 6008273, pp. 399-402. Cited 4 times.  
ISBN: 978-145770814-5  
doi: 10.1109/ICICIP.2011.6008273  
  
[View at Publisher](#)
- 
- 32 Ye, H., Luo, F., Xu, Y.  
Application of RBF network based on immune algorithm to predicting of wastewater treatment  
  
(2009) *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, 5553 LNCS (PART 3), pp. 1197-1202. Cited 4 times.  
ISBN: 3642015123; 978-364201512-0  
doi: 10.1007/978-3-642-01513-7\_133  
  
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