

[Home](#) > [Journal of the Brazilian Society of Mechanical Sciences and Engineering](#) > [Article](#)

Developing of ANN model for prediction of performance and emission characteristics of VCR engine with orange oil biodiesel blends

Technical Paper | Published: 29 March 2017

Volume 39, pages 2877–2888, (2017) [Cite this article](#)



[Journal of the Brazilian Society of Mechanical Sciences and Engineering](#)

[Aims and scope](#) →

[Submit manuscript](#) →



[V. Karthickeyan](#)¹, [P. Balamurugan](#) ¹, [G. Rohith](#)¹ & [R. Senthil](#)²

 501 Accesses  47 Citations [Explore all metrics](#) →

Abstract

Biodiesel is used as a valuable alternative to the conventional fossil fuel, as it is non-toxic, renewable and biodegradable resource. Engine parameters like compression ratio, injection timing and injection pressure play key role in the combustion of fuel. The present study focuses on ANN model for predicting the performance characteristics like brake thermal efficiency, brake specific fuel consumption and emission characteristics like carbon monoxide, oxides of nitrogen and hydrocarbon emissions at varying loads and compression ratios (17, 17.5, 18). Seven training algorithms each with four combinations of training

functions were investigated. Levenberg–Marquardt (trainlm) with log and tan sigmoidal transfer function provided the best results amongst the other six training algorithms. It was found to be an accurate predicting model for analyzing the performance and emission characteristics VCR engine with biodiesel blends. In all compression ratios, 20 OME showed better thermal efficiency and reduced fuel consumption than diesel. Lower CO and HC emissions were observed with 20 OME than diesel except NO_x.

 This is a preview of subscription content, [log in via an institution](#)  to check access.

Access this article

[Log in via an institution](#) →

Subscribe and save

Springer+ Basic

€32.70 /Month

- Get 10 units per month
- Download Article/Chapter or eBook
- 1 Unit = 1 Article or 1 Chapter
- Cancel anytime

[Subscribe now](#) →

Buy Now

[Buy article PDF 39,95 €](#)

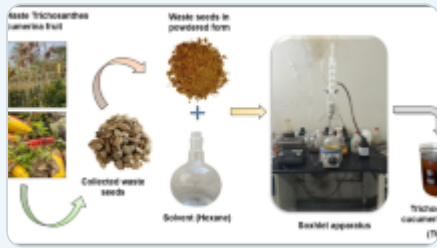
Price includes VAT (Poland)

Instant access to the full article PDF.

Rent this article via [DeepDyve](#) 

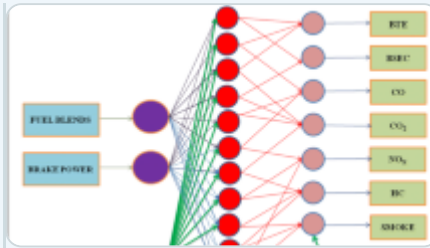
[Institutional subscriptions](#) →

Similar content being viewed by others



[ANN modeling for forecasting of VCR engine performance and emission parameters fuelled with green diesel...](#)

Article | 10 March 2022



[Forecasting of an ANN model for predicting behaviour of diesel engine energised by a combination of two low...](#)

Article | 05 September 2019



[Prediction of the WPPO Biodiesel-Fuelled HCCI Engine Using Artificial Neural Networks](#)

Chapter | © 2020

Abbreviations

VCR: Variable compression ratio

ANN: Artificial neural network

BTE: Brake thermal efficiency

BSFC: Brake specific fuel consumption

CO: Carbon monoxide

NO_x: Oxides of nitrogen

HC: Hydrocarbon

OME: Orange oil methyl ester

20 OME: 20% orange oil methyl ester + 80% neat diesel

CR: Compression ratio

References

1. Karthickeyan V, Balamurugan P, Senthil R (2016) Studies on orange oil methyl ester in diesel engine with hemispherical and toroidal combustion chamber. *Therm Sci* 20:981–989. doi:[10.2298/TSCI16S4981K](https://doi.org/10.2298/TSCI16S4981K)
[Article](#) [Google Scholar](#)
2. Karthickeyan V, Balamurugan P, Senthil R (2016) Production of orange oil methyl ester and experimental investigation on thermal barrier coated diesel engine. *Asian J Res Soc Sci Humanit* 6:156–178. doi:[10.5958/2249-7315.2016.00601.8](https://doi.org/10.5958/2249-7315.2016.00601.8)
[Google Scholar](#)
3. Karthickeyan V, Balamurugan P, Senthil R (2017) Investigation on environmental effects of thermal barrier coating with waste cooking palm oil methyl ester blends in diesel engine. *Biofuels* (Accepted for Publication)
4. Karthickeyan V, Arulraj P (2014) Experimental investigation on emission characteristics of catalytic converter using different wash coat material. *Appl Mech Mater* 550:62–70. doi:[10.4028/www.scientific.net/AMM.550.62](https://doi.org/10.4028/www.scientific.net/AMM.550.62)
[Article](#) [Google Scholar](#)
5. Karthickeyan V, Balamurugan P, Senthil R (2015) Experimental Investigation of tyre pyrolysis oil (TPO) in diesel engine without any engine modification. *J Biofuels Bioenergy* 1:170–183. doi:[10.5958/2454-8618.2015.00018.8](https://doi.org/10.5958/2454-8618.2015.00018.8)
[Article](#) [Google Scholar](#)
6. Ramadhas AS, Jayaraj S, Muraleedharan C (2004) Use of vegetable oils as IC engine fuels—a review. *Renew Energy* 29:727–742. doi:[10.1016/j.renene.2003.09.008](https://doi.org/10.1016/j.renene.2003.09.008)
[Article](#) [Google Scholar](#)

7. Naik SN, Goud VV, Rout PK, Dalai AK (2010) Production of first and second generation biofuels: a comprehensive review. *Renew Sustain Energy Rev* 14:578–597. doi:[10.1016/j.rser.2009.10.003](https://doi.org/10.1016/j.rser.2009.10.003)

[Article](#) [Google Scholar](#)

8. Atadashi IM, Aroua MK, Aziz AA (2011) Biodiesel separation and purification: a review. *Renew Energy* 36:437–443. doi:[10.1016/j.renene.2010.07.019](https://doi.org/10.1016/j.renene.2010.07.019)

[Article](#) [Google Scholar](#)

9. Najjar YSH, Amer MMB (2016) Using a smart device and neuro-fuzzy control system as a sustainable initiative with green cars. *J Energy Inst* 89:256–263. doi:[10.1016/j.joei.2015.01.021](https://doi.org/10.1016/j.joei.2015.01.021)

[Article](#) [Google Scholar](#)

10. Sharma YC, Singh B, Upadhyay SN (2008) Advancements in development and characterization of biodiesel: a review. *Fuel* 87:2355–2373. doi:[10.1016/j.fuel.2008.01.014](https://doi.org/10.1016/j.fuel.2008.01.014)

[Article](#) [Google Scholar](#)

11. Yogish H, Chandarshekhara K, Pramod Kumar MR (2013) A study of performance and emission characteristics of computerized CI engine with composite biodiesel blends as fuel at various injection pressures. *Heat Mass Transf und Stoffuebertragung* 49:1345–1355. doi:[10.1007/s00231-013-1181-4](https://doi.org/10.1007/s00231-013-1181-4)

[Article](#) [Google Scholar](#)

12. Vairamuthu G, Sundarapandian S, Thangagiri B (2016) Use of *Calophyllum inophyllum* biofuel blended with diesel in DI diesel engine modified with

nozzle holes and its size. Heat Mass Transf und Stoffuebertragung 52:1005-1013. doi:[10.1007/s00231-015-1623-2](https://doi.org/10.1007/s00231-015-1623-2)

[Article](#) [Google Scholar](#)

13. Purushothaman K, Nagarajan G (2009) Effect of injection pressure on heat release rate and emissions in CI engine using orange skin powder diesel solution. Energy Convers Manag 50:962-969. doi:[10.1016/j.enconman.2008.12.030](https://doi.org/10.1016/j.enconman.2008.12.030)

[Article](#) [Google Scholar](#)

14. Tüccar G, Tosun E, Özgür T, Aydın K (2014) Diesel engine emissions and performance from blends of *Citrus sinensis* biodiesel and diesel fuel. Fuel 132:7-11. doi:[10.1016/j.fuel.2014.04.065](https://doi.org/10.1016/j.fuel.2014.04.065)

[Article](#) [Google Scholar](#)

15. Muralidharan K, Vasudevan D (2011) Performance, emission and combustion characteristics of a variable compression ratio engine using methyl esters of waste cooking oil and diesel blends. Appl Energy 88:3959-3968. doi:[10.1016/j.apenergy.2011.04.014](https://doi.org/10.1016/j.apenergy.2011.04.014)

[Article](#) [Google Scholar](#)

16. Amarnath HK, Prabhakaran P (2012) A study on the thermal performance and emissions of a variable compression ratio diesel engine fuelled with karanja biodiesel and the optimization of parameters based on experimental data. Int J Green Energy 9:841-863. doi:[10.1080/15435075.2011.647167](https://doi.org/10.1080/15435075.2011.647167)

[Article](#) [Google Scholar](#)

17. Javed S, Murthy YVVS, Baig RU, Rao DP (2015) Development of ANN model for prediction of performance and emission characteristics of hydrogen dual

fueled diesel engine with Jatropha Methyl Ester biodiesel blends. J Nat Gas Sci Eng 26:549–557. doi:[10.1016/j.jngse.2015.06.041](https://doi.org/10.1016/j.jngse.2015.06.041)

[Article](#) [Google Scholar](#)

18. Roy S, Banerjee R, Das AK, Bose PK (2014) Development of an ANN based system identification tool to estimate the performance-emission characteristics of a CRDI assisted CNG dual fuel diesel engine. J Nat Gas Sci Eng 21:147–158. doi:[10.1016/j.jngse.2014.08.002](https://doi.org/10.1016/j.jngse.2014.08.002)

[Article](#) [Google Scholar](#)

19. Parlak A, Islamoglu Y, Yasar H, Egrisogut A (2006) Application of artificial neural network to predict specific fuel consumption and exhaust temperature for a diesel engine. Appl Therm Eng 26:824–828. doi:[10.1016/j.applthermaleng.2005.10.006](https://doi.org/10.1016/j.applthermaleng.2005.10.006)

[Article](#) [Google Scholar](#)

20. Uzun A (2012) A parametric study for specific fuel consumption of an intercooled diesel engine using a neural network. Fuel 93:189–199. doi:[10.1016/j.fuel.2011.11.004](https://doi.org/10.1016/j.fuel.2011.11.004)

[Article](#) [Google Scholar](#)

21. Bietresato M, Calcante A, Mazzetto F (2015) A neural network approach for indirectly estimating farm tractors engine performances. Fuel 143:144–154. doi:[10.1016/j.fuel.2014.11.019](https://doi.org/10.1016/j.fuel.2014.11.019)

[Article](#) [Google Scholar](#)

22. Oğuz H, Saritas I, Baydan HE (2010) Prediction of diesel engine performance using biofuels with artificial neural network. Expert Syst Appl 37:6579–6586. doi:[10.1016/j.eswa.2010.02.128](https://doi.org/10.1016/j.eswa.2010.02.128)

[Article](#) [Google Scholar](#)

23. Pai PS, Rao BPS (2011) Artificial neural network based prediction of performance and emission characteristics of a variable compression ratio CI engine using WCO as a biodiesel at different injection timings. Appl Energy 88:2344-2354. doi:[10.1016/j.apenergy.2010.12.030](https://doi.org/10.1016/j.apenergy.2010.12.030)

[Article](#) [Google Scholar](#)

24. Yusaf TF, Buttsworth DR, Saleh KH, Yousif BF (2010) CNG-diesel engine performance and exhaust emission analysis with the aid of artificial neural network. Appl Energy 87:1661-1669. doi:[10.1016/j.apenergy.2009.10.009](https://doi.org/10.1016/j.apenergy.2009.10.009)

[Article](#) [Google Scholar](#)

25. Roy S, Ghosh A, Das AK, Banerjee R (2014) A comparative study of GEP and an ANN strategy to model engine performance and emission characteristics of a CRDI assisted single cylinder diesel engine under CNG dual-fuel operation. J Nat Gas Sci Eng 21:814-828. doi:[10.1016/j.jngse.2014.10.024](https://doi.org/10.1016/j.jngse.2014.10.024)

[Article](#) [Google Scholar](#)

26. Holman JP (2007) Experimental techniques for engineers, 7th edn. Tata McGraw Hill, New Delhi

[Google Scholar](#)

27. Karthickeyan V, Balamurugan P, Senthil R (2016) Comparative studies on emission reduction in thermal barrier coated engine using single blend ratio of various non-edible oils. J Braz Soc Mech Sci Eng 1:1-11. doi:[10.1007/s40430-016-0645-0](https://doi.org/10.1007/s40430-016-0645-0)

[Google Scholar](#)

28. Karthickeyan V, Balamurugan P, Senthil R (2015) Investigation of CI engine fueled with ethanol nano additives blended diesel. Proc First Int Conf Recent

29. Taghavifar H, Taghavifar H, Mardani A et al (2015) A numerical investigation on the wall heat flux in a di diesel engine fueled with *n*-heptane using a coupled CFD and ANN approach. Fuel 140:227–236.
doi:[10.1016/j.fuel.2014.09.092](https://doi.org/10.1016/j.fuel.2014.09.092)

[Article](#) [Google Scholar](#)

30. Ismail HM, Ng HK, Queck CW, Gan S (2012) Artificial neural networks modelling of engine-out responses for a light-duty diesel engine fuelled with biodiesel blends. Appl Energy 92:769–777.
doi:[10.1016/j.apenergy.2011.08.027](https://doi.org/10.1016/j.apenergy.2011.08.027)

[Article](#) [Google Scholar](#)

Acknowledgements

The authors would like to express their thanks to University Grants Commission-South Eastern Regional Office, Hyderabad, India for financial support through Minor research project for teachers with Grant No. 4-4/2013-14 (MRP- SEM/UGC-SERO).

Author information

Authors and Affiliations

Department of Mechanical Engineering, Sri Krishna College of Engineering and Technology, Kuniamuthur, Coimbatore, 641 008, Tamil Nadu, India

V. Karthickeyan, P. Balamurugan & G. Rohith

Corresponding author

Correspondence to [P. Balamurugan](#).

Additional information

Technical Editor: Luis Fernando Figueira da Silva.

Electronic supplementary material

Below is the link to the electronic supplementary material.

[Appendix I Results of various performance metrics using the Matlab is attached \(DOCX 97 kb\)](#)

[Appendix II Details of the Matlab Simulation \(DOCX 797 kb\)](#)

Rights and permissions

[Reprints and permissions](#)

About this article

Cite this article

Karthickeyan, V., Balamurugan, P., Rohith, G. *et al.* Developing of ANN model for prediction of performance and emission characteristics of VCR engine with orange oil biodiesel blends. *J Braz. Soc. Mech. Sci. Eng.* **39**, 2877–2888 (2017). <https://doi.org/10.1007/s40430-017-0768-y>

04 November 2016

17 March 2017

29 March 2017

Issue Date

July 2017

DOI

<https://doi.org/10.1007/s40430-017-0768-y>

Keywords

[ANN prediction model](#)

[Orange oil methyl ester](#)

[Variable compression ratio](#)

[Diesel engine](#)

Search

Search by keyword or author



Navigation

Find a journal

Publish with us

Track your research