International Journal of Analytical, Experimental and Finite Element Analysis
Volume 10, Issue 3, August 2023, pp 114 - 118
https://doi.org/10.26706/ijaefea.3.10.20230806

3D CAD Model Retrieval and its Application: A Review

Hemant Dawande [1,*], Shantanu Kumar Das [2], Padmanabh Arun Gadge [1]

[1] G H Raisoni University, Saikheda, Madhya Pradesh, 480337, India
[2] Ajeenkya D Y Patil University, Pune, 412105, India

* Correspondence E-mail address: hemant.dawande.phdme@ghru.edu.in.

Abstract : The use of this model is particularly important, especially in the aerospace, shipbuilding, automotive, and other fields that are producing more and more three dimensional CAD models, as most existing 3D model retrieval methods such as are based on multilevel extraction, 3D CAD model semantics. Existing model retrieval methods are limited to the retrieval between similar models,granularity as the foundation for retrieving similarities The majority of these methods begin by extracting 3D model features, compare similarity based on those attributes, and subsequently accomplish retrieval goals. applications for retrieving 3D CAD models are numerous. One crucial aspect of product development that must be addressed before product realisation is the retrieval process. Different assembly joint information (liaison), including geometric and non-geometric information, is required in order to choose the most appropriate joining procedure. An active tool must be used to capture, represent, and reuse this knowledge across domains in order for the effective selection of model retrieval to take place.The designer needs ontology-based information to analyse these multiple design requirements, functional requirements, and production requirements for the choice of joining technique. This article suggests some uses for 3D CAD model retrieval.

Keywords: Reverse engineering, 3D model retrieval, Similarity, Digital model reuse

Review – Peer Reviewed
Received: 20 May 2023
Accepted: 25 July 2023
Published: 25 August

Cite this article: Hemant Dawande, Shantanu Kumar Das, Padmanabh Arun. Gadge, "3D CAD model retrieval and it's application: A Review", *International Journal of Analytical, Experimental and Finite Element Analysis*, RAME Publishers, vol. 10, issue 3, pp. 114-118, 2023.
https://doi.org/10.26706/ijaefea.3.10.20230806

1. Introduction

Building 3D CAD models for product design has gained popularity as a low-cost computational method. 3D CAD models are made up of numerous components with different forms and materials. The goal of 3D MODEL retrieval is to compare each model's similarity to the query,Therefore, the key to completing the 3D model retrieval assignment is understanding how to calculate the similarity between two 3D models. Maximising the reuse of current models and the accompanying data is the retrieval's primary goal and an effective strategy to enhance PDP. reducing the need to reinvent an existing solution, preventing the spread of identical models, and concentrating on truly new elements. Retrieval items can help achieve this objective.Retrieval of 3D models has many applications, including reverse engineering, product standardisation and rationalisation, digital model reuse, and product information reuse. various similarities if the sub-components in two assemblies are comparable These parallels are referred to as global, partial, and local similarities. Global similarities If two nodes have a neighbour that is also similar to them, they are said to be similar. partial resemblances- Even if two objects are different, they do share many parts. regional affinities Calculate the correlation between two signals in your area smoothly. PDP is complete, and the next stages of its lifespan begin. It is crucial for businesses aiming to reduce the number of iterations to capitalise on the knowledge of the existing products because the time and cost of production are affected by the number of iterations required to complete the PDP.

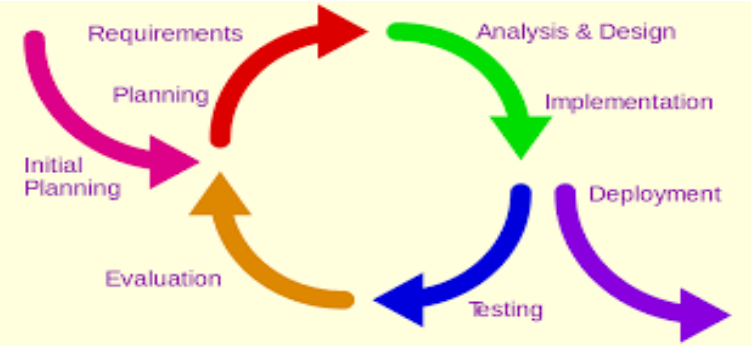

Figure 1. Iterative Product Development Process [4]

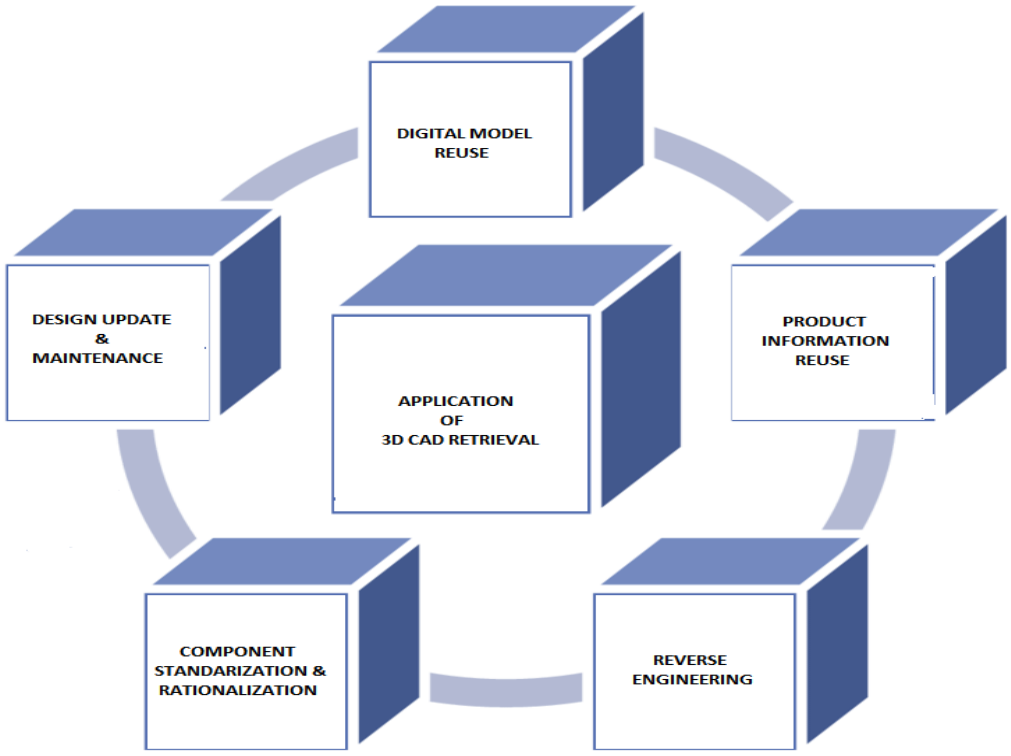

Figure 2 Application of 3D CAD Retrieval

The reusing of previously created components in new products, either in their original form or with small modifications, is known as digital model reuse. reuse of product information It describes the procedure for searching a database for design data and documentation related to a certain product. This technique enables rationalisation, Rationalisation is the process of lowering the number of products to develop so that more money may be spent on the one that makes the most money. Updating and maintaining the design Design update is the practise of updating models in response to shifting requirements or conditions that render them obsolete, whereas maintenance refers to the actions required to maintain the condition of an item by preventing damage caused by deterioration of components.,In the realm of mechanical engineering, reverse engineering is the process of developing a 3D digital model from a physical object.Furthermore, a further problem results from the variety of similarity levels that might be used to compare two assembly models. Two assemblies may in fact have global similarities but also have partial similarities, where partial similarity

In the example of Fig. 1.3, models M1 and M2 have similarities on a global scale, as well as partial similarities to M3 and M4 because the first two are contained in the latter two, and ultimately local similarities between M3 and M4 because they have similar subparts in common.

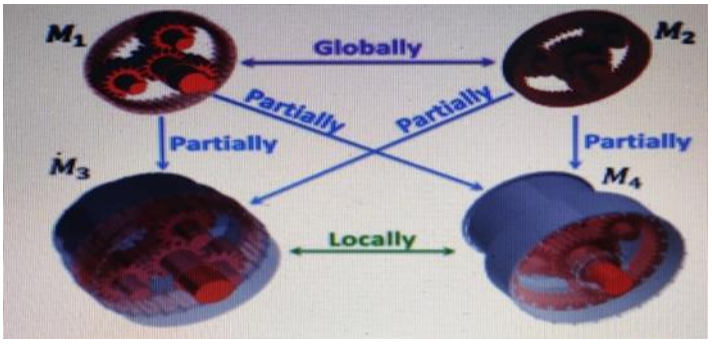

Figure 3. Different types of similarity among assembly models: local, partial and global similarity [4]

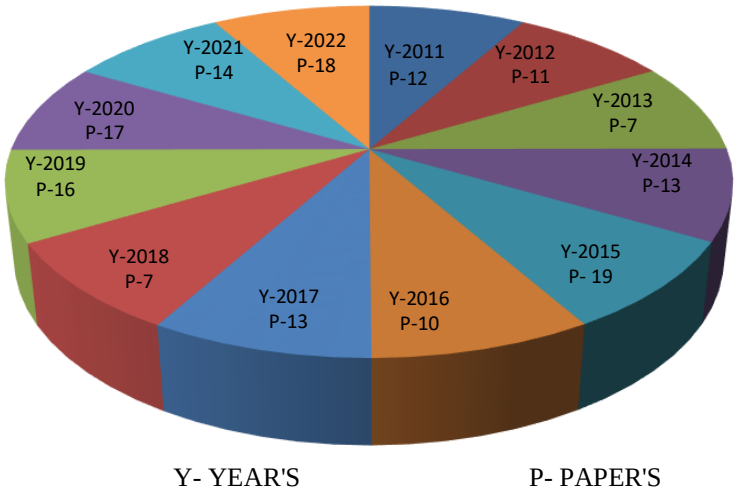

Figure 4. No. of Research papers publish in No. of year's

2. Literature review

Assembly model retrieval based on multi-source semantic data by Han, Z., Mo, et al. Using a fuzzy logic algorithm for multi-criteria evaluation, different assembly joining methods are ranked, and a case study is conducted to validate the methodology. Lupinetti, Katia, and others [3] In order to choose the procedures based on knowledge about joint geometry, joint characteristics, materials, production, and process, computer-aided design content-based retrieval methodology is utilised. A three-dimensional CAD model retrieval algorithm based on ontology was developed by Huag Mingcong et al. Clustering and retrieval of mechanical CAD assembly models using data from several sources, Zhoupeng Han [14] Computer-integrated manufacturing and robotics K. Lupinetti and co. [19] CAD assembly model retrieval using several criteria.

3. Conclusions and future work

Most studies focus on algorithms, multi-source semantic data, and fuzzy logic algorithms. In this review paper, which is about the application of 3D CAD retrieval, we want to find out if an expert system can be set up using an ontology-based methodology to choose the best joining strategy. Ontology-based techniques are the focus of very few researchers. and only a small number of scholars concentrate on the use of 3D CAD retrieval in reverse engineering. Following are some uses for reverse engineering: improving or changing the look of existing products, construction materials that are completely compatible with already-existing objects, Repairs must be made to parts that have worn out or broken. For older parts without drawings or CAD, creating a CAD file can create surfaces or features, such as organic-shaped components, that are very difficult to recreate without reverse engineering.

References

1. Han, Z., Mo, R., Yang, H., & Hao, L. (2018). CAD assembly model retrieval based on multi-source semanticsinformation and weighted bipartite graph. *Computers in Industry*, *96*, 54-65. https://doi.org/10.1016/j.compind.2018.01.003
2. Katia lupinetti, franca Giannini, Marina Monti, jean- philippe pernot CDE ELSEVIER Concurrent Engineering 23(1), 40–63 (2015)
3. Katia lupinetti jean-philippe pernot Marina Montia,Franca Giannine (2019) Content- based CAD assembly model retrieval : Survey and future challenges Computer-Aided Design 113 (2019) 62-81 https://doi.org/10.1016/j.cad.2019.03.005
4. Sang Min Jeon a, Jae Hyun Lee b, Gyeong June Hahm c, Hyo Won Suh:Automatic CAD model retrieval based on design documents using semantic processing and rule processing S.M. Jeon et al. / Computers in Industry 77 (2016) 29–47 https://doi.org/10.1007/s00170-018-2968-8
5. Fei Guo a, jiahuan Liu, Xiaowei Zhou, Hui Wang, Yun Zhang, Dequn Li, Huamin Zhou An effective retrieval method for 3D models in plastic injection molding for process reuse Applied Soft Computing Journal 101 (2021) 107034 https://doi.org/10.1016/j.asoc.2020.107034
6. Wenjine, Gary Mac,Nektarios Georgios Tsoutsos,Nikhil Gupta,Ramesh karri computer aided design CAD model search and retrieval using frequency domain file conversion https://doi.org/10.1016/j.addma.2020.101554
7. Fei Jie Zhang jiazhen Pang jianfeng Yu,Pan Wang : An efficient assembly retrieval method based on Hausdorff distance.Robotics and computer-integrated Manufacturing 51 (2018) 103-111 https://doi.org/10.1016/j.rcim.2017.11.012
8. Zhoupeng Han, Rong Mo,Li Hao Clustering and retrieval of mechanical CAD assembly models based on multi-source attributes information (2019) https://doi.org/10.1016/j.rcim.2019.01.003
9. Kaoru katayama,Member and Takashi HCRASHIMA,Nonmember IEICE TRANS.INF & SYST.VOL.103- D,No.5MAY2020
10. K.lupinetti,F.Giannini,M.Monti,J.P Pernot Multi-Criteria similarity assessment for CAD assembly model retrieval. https://doi.org/10.1016/j.compind.2019.07.001
11. Huag Mingcong, Suishaocum, Mouwenping,mZhangshusheng,cao wenjum Three-dimensional CAD ModelRetrieval Algorithm Based on ontology.procedia CIRP 56 (2016) 590-593 https://doi.org/10.1016/j.procir.2016.10.116
12. M.Rezayat knowelege-based product development using XML and kes comput –Aided Des 32 (s) (2000) 299-309 Z lik Ramani ontology based design information extraction and retrieval AI EDAM 21 (2007) 137-154 13.Wenjin Li, Gary Mac, Nektarios Georgios Tsousos, Nikhil Gupta, Ramesh korri:Computer aided design (CAD) model search and retrieval using frequency domain file conversion ELSEVIER Additive Manufacturing36 (2020) 101554 http://dx.doi.org/10.1016/S0010-4485(00)000130
14 Zhoupeng Han, Rong , Li Hao Clustering and retrieval of mechanical CAD assembly models based on multi -source attributes information. Robotics and Computer Integrated Manufacturing 58 (2019) 220–229 https://doi.org/10.1016/j.rcim.2019.01.003
15. Huang Mingconga,*, Sui Shaocuna, Mou Wenpinga, Zhangshushengb, Cao wenjun:Three-dimensional CAD Model Retrieval Algorithm Based on Ontology ELSEVIER Procedia CIRP 56 (2016) 590 – 593 https://doi.org/10.1016/j.procir.2016.10.116
16. Feiwei Qin , shuming Gao, xiaoling Yang, Ming Li jing Bai, An ontology-based semantic apporoach forhetrogeneous 3D CAD Model, ELSIVIER Advanced Engineering Informatics 30 (2016) 751–768 https://doi.org/10.1016/j.aei.2016.10.001
17. Jing Bareality for content-based image retrieval. In: IEEE International Conference on Multimedia and Expo, 2001. ICME 2001.(ICME).pp.4447(2001). https://doi.org/10.1109/ICME.2001.1237651
18. Henrique's, D., Mendes, D., Pascoal, P., Trancoso, I., Ferreira, A.: Poster: Evaluation of immersive visualization techniques for 3D object retrieval. In: 2014 IEEE Symposium on 3D User Interfaces (3DUI). pp. 145–146. IEEE (2014) https://doi.org/10.1109/3DUI.2014.6798862+
19 Lupinetti, K., Giannini, F., Monti, M., Pernot, J.P.: Multi-criteria retrieval of CAD assembly models. Journal of Computational Design and Engineering 5(1), 41 – 53 (2018) https://doi.org/10.1016/j.jcde.2017.11.003
20 Lupinetti, K., Giannini, F., Monti, M., Pernot, J.P.: Multi-criteria similarity assessment for CAD assembly models retrieval. IMATI Report Series (18- 07), 21 (08/2018 2018), http://irs.imati.cnr.it/reports/irs18-07 https://doi.org/10.1016/j.jcde.2017.11.003
21. Liu, L., Huai, Y.: Dynamic hand gesture recognition using lmc for flower and plant interaction. International Journal of Pattern Recognition and Artificial Intelligence 33(01),1950003(2018) https://doi.org/10.1142/S0218001419500034
22. n, C.S., Khoury, M.: Human Motion Sensing and Recognition. Springer (2017) https://doi.org/10.1007/978-3-662-53692-6
23. Lawson, G., Salanitri, D., Waterfield, B.: Future directions for the development of virtual reality within an automotive manufacturer. Applied ergonomics 53, 323–330 (2016) https://doi.org/10.1016/j.apergo.2015.06.024
24 Cook, M.: Virtual serendipity: preserving embodied browsing activity in the 21st century research library. The Journal of Academic Librarianship 44(1), 145–149 (2018) https://doi.org/10.1016/j.acalib.2017.09.003

25 Cordeiro, E., Giannini, F., Monti, M., Mendes, D., Ferreira, A.: A study on natural 3D shape manipulation in vr. In: Livesu, M., Pintore, G., Signoroni, A. (eds.) Smart Tools and Apps for Graphics - Eurographics Italian Chapter Conference. The Eurographics Association (2018). https://doi.org/10.2312/stag.20181296

26 Cui, J., Kuijper, A., Fellner, D.W., Sourin, A.: Understanding people's mental models of mid-air interaction for virtual assembly and shape modeling. In: Proceedings of the 29th International Conference on Computer Animation and Social Agents. pp.139–146.ACM(2016)https://doi.org/10.1145/2915926.2919330

27 Lawson, G., Salanitri, D., Water field, B.: Future directions for the development of virtual reality within an automotive manufacturer. Applied ergonomics 53, 323–330 (2016) https://doi.org/10.1016/j.apergo.2015.06.024

28 Cook, M.: Virtual serendipity: preserving embodied browsing activity in the 21st century research library. The Journal of Academic Librarianship 44(1), 145–149 (2018) https://doi.org/10.1016/j.acalib.2017.09.003

29 Cordeiro, E., Giannini, F., Monti, M., Mendes, D., Ferreira, A.: A study on natural 3D shape manipulation in vr. In: Livesu, M., Pintore, G., Signoroni, A. (eds.) Smart Tools and Apps for Graphics - Eurographics Italian Chapter Conference. The Eurographics Association (2018). https://doi.org/10.2312/stag.20181296

30 Cui, J., Kuijper, A., Fellner, D.W., Sourin, A.: Understanding people's mental models of mid-air interaction for virtual assembly and shape modeling. In: Proceedings of the 29th International Conference on Computer Animation and Social Agents. pp. 139–146. ACM (2016) https://doi.org/10.1145/2915926.2919330

31 Cui, J., Kuijper, A., Sourin, A.: Exploration of natural free-hand interaction for shape modeling using leap motion controller. In: 2016 International Conference on Cyberworlds (CW). pp. 41–48. IEEE (2016) https://doi.org/10.1109/CW.2016.14

32 Cui, J., Sourin, A.: Mid-air interaction with optical tracking for 3D modeling. Computers & Graphics 74, 1– 11 (2018) https://doi.org/10.32657%2F10220%2F48020

33 Gunawardane, P., Medagedara, and N.T.: Comparison of hand gesture inputs of leap motion controller & data glove in to a soft finger. In: Robotics and Intelligent Sensors (IRIS), 2017 IEEE International Symposium on. pp. 62– 68. IEEE (2017 https://doi.org/10.1109/IRIS.2017.8250099

34 Henriques, D., Mendes, D., Pascoal, P., Trancoso, I., Ferreira, A.: Poster: Evaluation of immersive visualization techniques for 3D object retrieval. In: 2014 IEEE Symposium on 3D User Interfaces (3DUI). pp. 145–146. IEEE (2014) https://doi.org/10.1109/3DUI.2014.6798862