REVIEW PAPER:INFORMATION HIDING IN 3D MODELS USING MULTI-OBJECTIVE GENETIC ALGORITHM

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***Abstract*—With the outburst of multimedia matter over World Wide Web,it makes need for oligopoly protection of digital matter where it can be music albums swapped from one network to another network ,or videos uploaded over websites such as Flickr,tumblrSmugMug,Youtube.com or 3D models such as the incredibles, creator need to protect possession of the matter. 3D watermarking protects intellectual property from the hackers which are embedded into 3D model.Smacking of the digital information into the carrier signal ; the hidden information should, but it might not need to contain a relation to the carrier signal is the watermarking technique.The originality or integrity of the carrier signal or to show the congruity of its owners the digital watermarks can be used for verification.Their is usage of the non-conventional methods in the Intelligent watermarking techniques like Evolutionary Computation techniques to satisfy the exchange between integrity and authenticity of digitized matter. The problem of using Triangle similarity quadruple (TSQ) ,Tetrahedral volume ratio (TVR) , Mesh density pattern(MDP)algorithm,Vector Evaluated Genetic Algorithm(VEGA) as embedding algorithm has been reviewed and to solve the problem we intoduced Multi-Objective Genetic Algorithm as embedding in this paper with its applications and advantages.**

***Keywords*— Watermarking, Robustness.Steganalysis ,Imperceptibility,Gaussian noise,Biometrics**

I. INTRODUCTION

A 3DMesh consist of vertices ,faces ,edges which connect to the vertices the coordinates.The imperceptible data is embedded with the help of watermarking techniques into the multimedia matter.The clandestinely embed data is known as the watermark and which may consist of cryptographic keys, possessorship messages .the strong Requirement of the imperceptibility is considered because the watermark should not interfere with its intentional function.

There are different methods for watermarking detection that are non-blind(while retrieving process it requires access to any of the original content),semi-blind(while detecting watermark the detector requires uphold information but not the original matter),blind(without ingress to the original matter the detection is performed).

Watermarking algorithms can also be classified into first,second,third generations of watermarking.The generations are classified on the basis of capabilities of the algorithms. In first generation watermarking algorithms spatial domain extract features and also it classified into two main categories: Connectivity-driven watermarking schemes and Geometry-driven watermarking schemes . the spatial domain schemes are less robust and less complex.

The second generation watermarking overcomes the problems of the first generation watermarking like capacity, invisiblity,robustn-

ness of the watermark .second generation algorithms .the second generation algorithm applies the watermarking approach to stream meshes and also it increases robustness of

algorithm at multiple resolutions by insertion of watermark.

Third generation watermarking schemes are built on the bases of first and second generation schemes by adding intelligent watermark layer which include optimization/classification.the third generation watermarking maximizes the amount of watermark insertion in 3D model without causing perceptible distortion .

The aim of using multi-objective genetic algorithm is to find all possible commutation among multi-objective optimization functions that are usually disputed.Multi-Objective Genetic Algorithm has high embedding capacity feature than Genetic Algorithm and other embedding algorithms without causing perceptible distortion.It can minimize distortion and maximize the embedding capacity.The algorithm generates and embeds a watermark in each and every vertex of the model.

Tadahiko Murata and Hisao Ishibuchi has defined steps for execution Multi-Objective Genetic Algorithm are as follows[12]:-

Step 0(Initialization):-The creatation of an initial population containing Npop where Npop is the number of the strings.

Step 1(Evaluation):-Calculation of the values of the initial population containing Npop strings where Npop is the number of strings in each population.

Step 2(Selection):-Calculation of the fitness value of each strings by using some random weights.

Step 3(Crossover):-Apply crossover operation for generating two more strings are for each selected pair. By the crossover operation Npop strings are generated.

Step4(Mutation):-Apply the mutation operation with a pre-determined mutation probability for each corner value which strings generated by the crossover operation.

Step 5(Elitist Strategy):- Accidentally remove the Nelite strings from the Npop strings generated by the previous operations, and replace them with Npop accidentally strings selected from the tentative set of Pareto optimal solutions.

Step6(Termination Test):-If a pre-specified stopping conditions is not satisfied,return to step 1.

Step7(User selection):-The Multi-Objective Genetic Algorithm shows the final set of Pareto-optimal solutions to the decision maker.

II. LITERATURE SURVEY

C.L. Mumford , L.C. Jain and S. Sumathi , S. Paneerselvam defined that the computational intelligence is the study of accustomed mechanism to capacitate or simplify intelligent behaviour in convoluted, precarious, changing ambience.These accustomed mechanisms include those Artificial Intelligence paradigms that shows a competence to learn new situations ,abstract ,discover and associate.The basic requirement of the watermark algorithms is that the watermark should be imperceptible to fend off being recognized and not induce visible distortion to the observer.To combat from unintentional ambushes the watermark should also be robust.The watermark insertion scope should be as lofty as possible to combat intentional ambushes.[2]

R. Ohbuchi, H. Masuda, and M. Aono used different embedding algorithms such as Triangle similarity quadruple (TSQ) ,Tetrahedral volume ratio (TVR) , Mesh density pattern (MDP) algorithm these are merely examples of providing information channels in a 3D polygon model.The disadvantage of these algorithms are that they are not robust enough for proving that thievery has occurred .[5]

Oliver Benedens bin encoding algorithm is the most successful algorithm.A bin is an entity for embedding one bit of watermarked data. One drawback of this algorithm is that the large amount of an earlier data needed before watermarked recuperation.For private watermarks,this is endurable.The watermarking system proposed doesn’t match embedding public watermarks because the system can not be performed without a certain amount of previous data that must be known to the reader in advance of watermark retrieval.[6]

Patrice Rondao Alface, Benoit Macq proposed a new blind robust watermarking scheme for 3D

meshes. Here the feature points are cast-off to congregate a partition of the mesh shape that to respond to common 3D watermarking ambush. This technique is not restricted to the watermarking field but it could be in several applications and also improvement of the accuracy for the different steps to get better resist irregular changes of the surface sampling rate . [1]

Mukesh Motwani, Rakhi Motwani, and Frederick Harris a fragile watermarking technique using genetic algorithms has been proposed.Genetic Algorithm initiates and embeds a watermark in each and every vertex of the model.Genetic algorithms are known to be slow,but the method of early encounter used this paper construct the proposed algorithm computationally inexpensive. The disadvantages of using GA are it's black art,produces incomprehensible solutions.[3]

Roland Hu, Patrice Rondao-Alface and Benot Macq have proposed a histogram-based method for watermarking 3D polygon meshes by using quadratic programming to reduce the mean square error between the original mesh and watermarked mesh. Correct bit rate (CBR)method is defined as the ratio of correctly decoded bits to all embedded bits.This method works better in Gaussian noise,thus probably is a better watermarking algorithm.This method gives problem while dealing with large meshes because of the complexity curb of peers and existing QP solvers. [8]

Suk-Hwan Lee ,Seong-Geun Kwon, Eung-Joo Lee, KwangSeok Moon, Won-JooHwang and Ki-Ryong Kwon presents the watermarking for 3D keyframe animation model based on the geometric property of hierarchical object meshes.For transfiguring nodes among the complete hierarchical layout their scheme selects arbitrary the embedding object. Their experimental verifies that the proposed scheme is robust to geometric attacks as well as timeline attacks that are used in general 3D graphic editing tools also the proposed algorithm has robustness against bend, taper, noise ,mesh smooth . The disadvantages of the algorithm used in this paper is that it gives less security at polygon editing in geometrical attacks and timeline attacks as well as the obscure .[10]

Zhenyu Li , Adrian G. Bors proposed to use a new local feature set for 3D mesh steganalysis, which includes the vertex normals and the local curvature. Steganalysis is a method to recognize whether a definite media was altered with the aim to conceal information. Machine Learning algorithms are used in this system for the learning to distinguish between those 3D objects which are used for carriers of hidden information and those are not used. To furnish flawless performance to other loom in a well known database of 3D objects the 3D steganalysis method is demonstrated.The disadvantage of this method is that it requires a pair relationship between the objects in the original cover source . However, if this kind of pairwise relationship doesn't exist between two completely separate cover sources, the proposed method of calculating the features robustness cannot be properly implemented.[13]

Samir B. Patel the novel technique has been developed to preserve the proprietary rights information of the digital content by watermarking on gray and color digital images unite the concept and image processing.Here the approach is evaluated against framework like Capacity of Embedding,Multiple time Embedding ,Robustness ,Security ,Imperceptibility and all pounce of different types.In operations like In Prewitt and Sobel filter,dithering operations ,uniform quantization and minimum variance color Quantization the frailty of the algorithm was remarked.[9]

Rakhi C. Motwani,Sergiu M. Dascalu,Frederick C. Harris proposes a novel watermarking scheme for copyright protection of 3D models based on voice biometrics for the purpose of owner recognition,traitor tracing and access control schemes.They used the voice print formulation technique which has been borrowed from the state-of-the -art speaker verification systems.Their experimental results indicate that the biometric watermark is resistant to cropping ,low levels of Gaussian noise addition and is tolerant to mesh smoothing attacks. In the order of tens of kilobytes, thereby demanding higher embedding capacity algorithms for watermarking the system has not dispatched superior results for 3D models.[7]

Tadahiko Murata and Hisao Ishibuchi have proposed a framework of genetic algorithms to search for Pareto optimal solutions (i.e., non-dominated solutions) of multi-objective optimization problems. Their approach has two characteristics features. First characteristic are concomitant on the weights which used for integrating multiple objectives into a scalar fitness function which are arbitrary specified for each selection. Second characteristic is the multiple elite

individuals sort out from a tentative set of Pareto optimal solutions which are inherited to the next generation.By computer imitation , they exhibited that the proposed MOGA (Multi-Objective Genetic Algorithm) could find better solutions than the VEGA(Vector Evaluated Genetic Algorithm). Multi-objective optimization (also well-known as multi attribute optimization or Pareto optimization) is fragment of a multiple criteria conclusion making that is anxious with mathematical optimization problems include more than one objective function to be optimized concurrently.[12]

III. PROPOSED SYSTEM

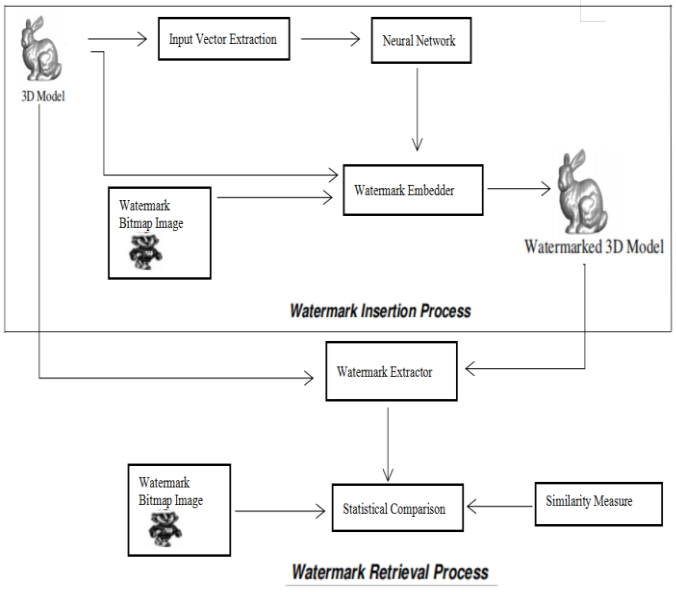

Fig. Watermarking system using Artificial Neural Network

The objective of using the artificial neural network is to watermark a 3D model in those regions which will create imperceptible distortions in the final watermarked model.For recognizing different topologies of one-ring of vertices of a model the artificial neural network is trained.An artificial neural network is chosen for culling vertices that are categorized as suitable for watermark insertion.For achieving higher embedding capacity the array of neural networks are used.The watermark extraction process is notified , needs the original watermark and 3D model. The watermarking evolutionary optimization process or algorithm is to understand the maximization or minimization through the choice of a fitness function but with ignorance of the details of exactly how that goal is achieved since there is randomness involved in achieving that goal.

1. ADVANTAGES

Mukesh Motwani and Dr. Frederick C. Harris explained the third generation framework capabilities.that are 3D Compression and New Watermarking Attacks. Compression and watermarking can be perceived as complementary problem.[4]The objective of compression is to clear away the information without leading to perceptible distortion.A good watermarking method can be a good watermark attack as well.Example,the method described using multi-objective genetic algorithm is used for inserting multiple watermarks,or eradicate the existing watermark as well.Multi-Objective Genetic Algorithm minimize distortion and maximize the embedding capacity.

2. APPLICATIONS

This system is useful for the copyright protection and ,piracy identification,

Also for processing large 3D model files.

For Source tracking(different recipients get differently watermarked content)

IV. CONCLUSIONS

In this paper, we proposed that computer intelligence techniques minimizes distortion and maximizes amount of watermark.We have demonstrated that multi-objective genetic algortihm watermarking scheme is robust against attacks such as mesh simplification, addition of noise, model cropping, and at the same time achieve a high level of imperceptibility.3D mesh watermarking is engrossing and optimistic research area , with many latent practical applications.For example, a digital artist could insert watermark into the 3D models to protect its ownership properties. However,there are many difficulties such as the irregularity of the mesh illustration and the complexity of the possible attacks.

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REFERENCES

[1] Alface, P. R., & Macq, B. 2005. Blind watermarking of 3D meshes using robust feature points detection. IEEE International Conference on Image Processing 2005. doi:10.1109/icip.2005.1529845,IEEE .Genova, Italy

[2] C.L. Mumford and L.C. Jain,2009 Computational Intelligence: Collaboration, Fusion and Emergence. Intelligent Systems Reference Library. Springer-Verlag Berlin Heidelberg

[3] Mukesh Motwani, Rakhi Motwani, and Frederick Harris, Jr.,2010,September..Fragile Watermarking of 3D Models Using Genetic Algorithms.Journal of Electronic Science and Technology and Technology of China.Vol.8,No.3.doi: 10.3969/j.issn.1674-862X.2010.03.008

[4] Mukesh C. Motwani,Frederick C. Harris,2011.Third Generation 3D Watermarking: Applied Computational Intelligence Techniques,Dissertation for the degree of Doctor of Philosophy in Computer Science and Engineering ,University of Nevada, Reno.

[5] Ohbuchi, R., Masuda, H., & Aono, M. 1998 .Watermarking three-dimensional polygonal models through geometric and topological modifications. IEEE Journal on Selected Areas in Communications, 16(4), 551–560. doi:10.1109/49.668977.

[6] Oliver Benedens ,1999. Geometry-based watermarking of 3D models. IEEE Computer Graphics and Applications, 19(1), 46–55. doi:10.1109/38.736468

[7] Rakhi C. Motwani ; Sergiu M. Dascalu ; Frederick C. Harris ,2010.Voice biometric watermarking of 3D models.2010 2nd International Conference on Computer Engineering and Technology
doi: 10.1109/ICCET.2010.5485658 .IEEE.Chengdu, China

[8] Roland Hu ,Patrice Rondao-Alface ,Benoit Macq ,2009.Constrained optimization of 3D Polygonal Mesh Watermarking by Quadratic Programming2009 IEEE International Conference on Acoustics, Speech and Signal Processing doi.10.1109/ICASSP.2009.4959880.IEEE.Taipei, Taiwan.

[9] Samir B. Pate,l 2017.Digital Watermarking using Decision Tree on Color Images 2017 International Conference on Energy, Communication, Data Analytics and Soft Computing .doi.10.1109/ICECDS.2017.8389591.IEEE.Chennai, India.

[10] Suk-Hwan Lee , Seong-Geun Kwon, Eung-Joo Lee , KwangSeok Moon , Won-Joo Hwang and Ki-Ryong Kwon ,2012.Watermarking Scheme for Copyright Protection of 3d Animated Model.2012 IEEE Consumer Communications and Networking Conference doi.10.1109/CCNC.2012.6181052.IEEE.Las Vegas, NV, USA

[11] S. Sumathi and S. Paneerselvam ,2009 .Computational Intelligence Paradigms: The Theory & Applications Using MATLAB. Taylor and Francis,USA.

[12] T. Murata and H. Ishibuchi, 1995.November"MOGA: Multi-objective genetic algorithms," Proc. of 1995 IEEE International Conference on Evolutionary Computation,(pp. 289-294), Perth, Australia.

[13] Zhenyu Li , Adrian G. Bors.,2016 .3D Mesh Steganalysis using local shape features .2016 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP).(pp.2144-2148)IEEE.Shanghai, China