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Abstracts of Short Papers

Terrain Synthesis Guided by User Hand Sketch

Shuangshuang Zhou, Zilong Song, Hongyan Quan, Changbo Wang

Abstract

Providing interactive user control is a strong need for authoring re-alistic terrains in constructing 3-D virtual scenes. Here, a framework is pro-posed for customizing terrain under the flexible control of intuitive sketch provided by user. Compared with the previous work, it learns the salient fea-tures from example terrain of Digital Elevation Model (DEM) and then maps them into the user terrain customization, which avoids much higher computa-tional cost from tedious complex terrain modeling and meet the needs of us-er personal customization. In our learning stage, the Radial Basis Function (RBF) network model is trained using the data set constituting of data map-ping pairs between the distance and geometry height of every selected fea-ture points with salient details. While in the synthesis stage, the terrain geom-etry is predicted from RBF model and registered the example DEM guided by the control of sketch user input, and then realistic synthesis result can be achieved. The experimental results show that our proposed method can achieve vivid realistic results under user control and synthesize pre-defined geomorphology terrain to meet the strong need of user flexible necessary.

CloudDTH: A Novel Framework for Modeling and Simulation of the Elderly Healthcare Services in Cloud

Ying Liu, Lin Zhang, Lei Ren, Yuan Yang, Weicun Zhang, Zhibo Pang

Abstract

In recent years, with the development of CPS, and IoT technologies, digital twin has been applied in the industry as a precision simulation technology from concept to practice. Combining digital twin with the medical field to create accurate medical models can provide more accurate and real-time treatments for the elderly medical services in cloud. In this paper we propose CloudDTH: a novel generalized and extensible framework that enables monitoring, life prediction and fault diagnosis of medical devices and sensors, scheduling and optimization of medical pathways and resource allocations, real-time health monitoring and crisis warning of elderly. The contributions of this paper includes: (1) Digital twin healthcare (DTH) was proposed for real-time supervision and accuracy of the crisis warning for the elderly. (2) The reference framework of CloudDTH is constructed. (3) Case scenarios for application are given to illustrate its feasibility.

Research on Applying and Actualizing Technique of Modeling and Simulating for Multidisciplinary Virtual Prototype

Liu Xiaoliang, Tao Luan, Zhou Junhua, Shi Guoqiang, Ji Hang, Zhai Xiang

Abstract

This paper briefly introduced the commonly used modeling and simulation methods of multidisciplinary virtual prototyping for complex products. Based on the engineering project, this paper introduced the components and technical features of the multidisciplinary virtual prototype engineering supporting platform COSIM, which is based on the multidisciplinary modeling and collaborative simulation method of the HLA, then introduced the application and development process of the COSIM platform. The application of COSIM platform for aerospace complex products was introduced, and the implementation steps and application results are expounded. Research and application showed that the application of multidisciplinary collaborative modeling and simulation based on COSIM to implement the design and development of aerospace complex product is an effective method to promote the manufacturing enterprise to realize the integration, digitalization, virtualization and intelligence of product development.

Efficient rendering of large-scale CAD models on a GPU virtualization architecture with model geometry metrics

Xue Junjie, Zhou Junhua, Shi Guoqiang, Qu Huiyang

Abstract

Three-dimensional model visualization serves a vital role on the visual expression of simulation data and process in computer simulations. As the credibility requirements for simulation increase in the development of complex products, simulation systems need to utilize high-precision full-size 3D models to perform simulation calculations. However, the full-size 3D models of complex products (such as detailed airplane CAD models) have huge data sizes and are extremely complex, which make it difficult to meet the requirement for high rendering efficiency in the simulation applications merely relying on the performance of existing computer hardware. In this paper, a model geometry metric method is proposed based on minimum bounding box and multi-view projections, which is able to accurately identify narrow and irregular small parts in massive CAD models. Then, combining with a GPU-based visibility culling approach and a model-details-filtering based adaptive LOD rendering algorithm, the real-time rendering rate of massive CAD models is highly improved. Moreover, a sort-first parallel rendering with a cluster of virtual machines is implemented on a virtual GPU (vGPU) architecture in order to achieve higher rendering speed by exploiting high computing capability of vGPUs. A prototype software system is developed to render large-scale CAD models with the proposed architecture and algorithms. The experimental results show that users can explorer CAD dataset with hundreds of millions of triangles in interactive frame rate with our technique.

A Sequential Neighbor Exploratory Method for Complex System Experiment Design

Wei Dong, Yonglin Lei

Abstract

The selection of training data is crucial for the establishment of complex system metamodels. The most direct way to improve the ability of training data to reflect the relationship between input and output of complex systems is to increase the factor level density. Since the number of experiments is the number of factors of the horizontal number, increasing the factor level density will cause serious dimension explosion problems. This paper proposes a sequential neighbor exploration design method that supports simulation meta-modeling. This method produces as few experimental points as possible and extracts the most useful information that can describe the system characteristics, helping to reduce the impact of dimensional explosions. The simulation results obtained with this experimental design method can be used as training data for regression models such as Random Forest (RF), Support Vector Regression (SVR), and Neural Network Regression (NNR). This case study compares the reproducibility of the original system based on the support vector regression model trained by training data of two different experimental design methods. The peaks function is used as an example to verify the regression results under the same test times.

SMA-oriented Combat System Effectiveness Simulation based on MDE

Yonglin Lei, Zhi Zhu, Qun Li

Abstract

Combat system effectiveness simulation (CESS) is a special type of complex system simulation. Three non-functional requirements (NFRs), i.e. model composability, domain specific modeling, and model evolvability are gaining higher priority from CESS users when evaluating different modeling methodologies for CESS. Traditional CESS modeling methodologies are either domain-neutral (lack of domain characteristics consideration and limited support for model composability) or domain-oriented (lack of openness and evolvability) and fall short of the three NFRs. Inspired by the concept of architecture in systems engineering and software engineering fields, we extend it into a concept of simulation model architecture (SMA) for complex simulation systems, and propose a SMA-oriented modeling methodology in which SMA plays a central role in achieving the three NFRs. Various model-driven engineering (MDE) approaches and technologies, including SMP, UML, DSM, EMF, GMF, and so forth, are applied where possible in representing the CESS SMA and its components' behaviors from physical and cognitive domain aspects.

Design Directed Network with Optimal Controllability

Liang Bai, Yandong Xiao, Haoran Wang, Songyang Lao

Abstract

The directedness of the links in a network plays a critical role in determining many dynamical processes among which the con- trollability has received much recent attention. Even the edge directions can determine the controllability of complex networks. Obviously, for a given network, we wish to design its edge directions that make this net- work approach the optimal controllability. In this work, we first introduce two methods to enhance network by assigning edge directions. However, these two methods could not completely mitigate the negative effects of inaccessibility and dilations. Thus, to approach the optimal network controllability, the edge directions must mitigate the negative effects of inaccessibility and dilations as much as possible. Finally, we systematically propose the definition and framework of how to design network with optimal controllability by a transformation idea, called edge direction for optimal controllability. The optimal method has been found to be successfully useful on real-world and synthetic networks.

Research on Uncertainty of Target Position Estimation in Combat Simulation

Qihao Hou, Yiping Yao, Feng Zhu

Abstract

Target position estimation is valuable for sensor detection and weapon attack. However, there is position uncertainty due to sensor detection accuracy and environmental noise. In this paper, the uncertainty region is graphically represented by area of uncertainty(AOU), and the error ellipses represent the error dispersal of 2D target s position. Calculate AOU using Extended Kalman Filter (EKF) algorithm and Dead Reckon(DR) algorithm. EKF covariance matrix is used for calculating AOU while estimating target position; The dead reckon algorithm realizes the update of AOU by calculating the time difference based on the last time's AOU. Finally, it was implemented and operated in a naval combat system, which verifies the effectiveness of the algorithms.

Simulation of Team Communication and Shared Situation Awareness

Sentaro Yojima, Taro Kanno, Kazuo Furuta

Abstract:

A team is a dynamic human system that enables people to work more effi-ciently and effectively. It is more than just a summation of individual ef-forts. On the other hand, there are cases in which team performance drasti-cally declines due to miscommunications and misunderstandings. In order to better understand the mechanism and dynamics of team cooperation, our previous research developed a simulation of the cognitive processes in team cooperation based on a theoretical model of team cognition and completed a first run study. However, detailed simulations and analysis were not per-formed, and some model parameters were set arbitrarily. This paper pro-poses extensions of the model to consider the effect of task difficulty on team performance and shows results of the simulation using the new model. In addition, the paper presents experiments and a questionnaire to gather data about human cognition in team communication to inform model parameter settings for future studies.

Agent-based Simulation of Multilateral Bargaining Game Theory for Electricity Market Bidding

Wu Jiahui, Fan Wenhui

Abstract

Electricity market is a complex system in which its participants interact with each other and influence each other. Computer simulation has become one of the main methods for the study of electricity market because it is often difficult to describe them with precise quantitative mathematical models. How to establish a perfect electricity market has always been a key research issue in the electric power industry, and the most important thing is the bidding mechanism. This article studies agent-based modeling and simulation method by which we studies the electricity market with imperfect competition. We presents an multi-agent-based simulation method for power market bidding, which is able to simulate the dynamic bidding process among the government, power grid companies, power plant companies, and consumer parties in the market, and a multi-agent simulation model of electricity market bidding based on game theory is established. The method of agent-based four-party competitive dynamic bidding simulation in the electricity market is implemented by Anylogic software. The results provide a theory reference for further understanding the bidding mechanism of electricity market.

Research on hydrodynamic characteristics of Autonomous Underwater Vehicle based on AWQA

Tao Zichuan, Liu Li, Zhou Yuying

Abstract

The design of Autonomous Underwater Vehicle (AUV) needs to consider its own hydrodynamic characteristics. To absorb and use the energy of roll motion, it's necessary to analyze the movement of the ship. At present hydrodynamic analysis of ship hull needs a large amount of calculation, so it needs auxiliary calculation by computer software. The hydrodynamic characteristics of a small AUV are studied by using AQWA based hydrodynamic analysis. By analyzing the hydrodynamic characteristics of a small AUV in different depths in the ocean, we find out the rules and complete basic research for the subsequent design of AUV, which is convenient for better exploitation of marine resources.

Derivation of an Optimal Location of Hub Airport Considering Regional Airports

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Keywords: Hub and spoke network, Hub-Airport, Regional airport, Low cost carrier, Local revitalization

Aviation industry is a typical network industry. The network efficiency that improves convenience because of more users plays an important role[1]. One of the networks for the aviation industry is Hub-and-Spoke Network. This model shows that hub airport is set as a base in many airports where it connects to other airports and makes an airline network. However, there are disadvantages. One of the big problems is that it forces passengers to transit at the hub airport. Sometimes, it needs a long time transit for over 6 hours. This tendency is particularly evident among Low-Cost Carrier (LCC) even though this demand for it has been increasing. So, maintaining the regional airports and airline routes in Japan is an important task[2]. Recently, the government has promoted it into regional airports. In addition, Peach Aviation sells local products and publishes information magazines of local areas[3][4]. If the problem about a long time transit could be solved, a large influence on increasing the number of users for LCC and regional airport can be expected. In this study, an optimal location of hub airport is proposed that the passengers go sightseeing a world heritage during a long transit time using by AHP and Multi-Agent simulation. Then, we show that regional airport can be a hub airport because of such an additional value. In addition, we considered the local revitalization from the increasing number of airport users.

In order to choose the airport for a hub airport, it needs to be considered that some alternative airports in Japan. The alternative airports were selected from the nearest airports to the locations registered as world heritage sites. On October 2017, 21 locations had been registered as world heritage sites in Japan. So, we looked up how to get the world heritage site to the nearest airports, since it is important for passengers to go somewhere easily for sightseeing within a limited time. This prefer to have an easily accessible transportation between an airport and world heritage site by transportation. As a result, 13 Airports including regional airports were selected as the alternative airports in this study. The first step in AHP analysis is to build a hierarchy for making the decision. In order to derive an optimal location of hub airport, these three items: Required time, Number of transit and Fare are selected as the evaluation criteria. These evaluation criteria items are required to move one way between the airport and the world heritage site. Then, alternative options are 13 airports in Japan. Based on this hierarchy, the weights for alternative options are derived from weights for the evaluation criteria and alternative options to the evaluation criteria. Firstly, a comparison matrix is set up to carry out pairwise comparisons of the relative importance of factors for the objective. With this result of pairwise comparisons, the weight for each evaluation criteria items and alternative option is generated by the geometric mean of the pairwise comparisons values.

Fig. 2 shows the weights for each evaluation criteria items and total weights for each airport as the result of AHP.

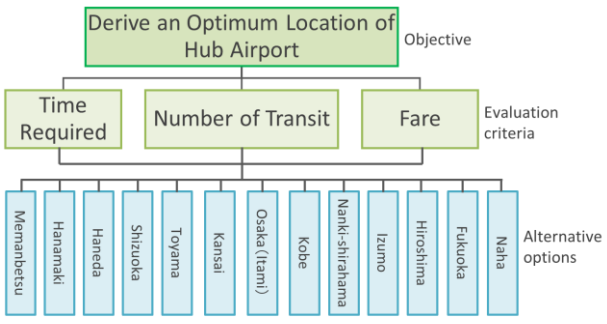

Fig. 1. AHP hierarchical chart

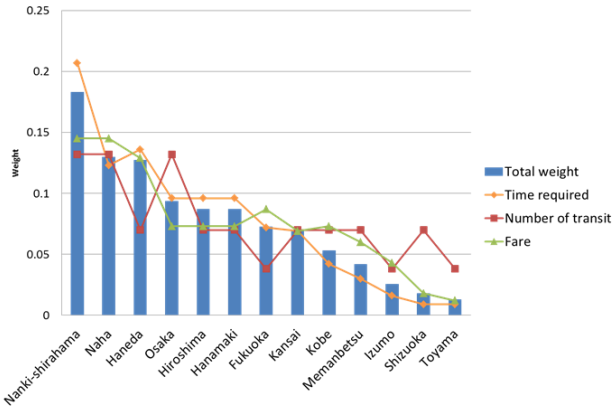

Fig. 2. Result of AHP

Based on the total weights from AHP, we calculated the probabilities that an airplane arrives at an airport from another airport. Then, Multi-Agent simulation was performed to confirm the validity of the result of AHP. In the simulation, 5 airplanes were set as agents and 13 airports were nodes.
Firstly, initial place was selected from 13 alternative airports randomly. Then, the destination of the airplane was selected based on a cumulative probability distribution by making a random number. this flow repeated 1000 times for each airplane and counted the arrival times of each airport. Table 1 shows the result of this simulation. We found that Nanki-shirahama airport is the optimal location for the hub airport in this result. It could be confirmed the validity of the AHP and an optimal location for hub airport was derived.

Table 1. Probability of arrival times for each airport

	Agent1	Agent2	Agent3	Agent4	Agent5
Nanki-shirahama	149	166	158	165	185
Naha	134	137	118	114	129
Haneda	117	114	127	118	116
Osaka	92	86	100	99	90
Hanamaki	94	92	91	95	96
Hiroshima	89	95	88	86	69
Fukuoka	92	73	77	82	69
Kansai	71	79	60	81	84
Kobe	59	62	60	43	55
Memanbetsu	44	41	55	49	48
Izumo	31	22	25	28	27
Shizuoka	19	20	24	22	18
Toyama	9	13	17	18	14

Next, the flight network of domestic airports which can maximize the number of airport users is derived to contribute to revitalization around the airport. Specifically, when Nanki-shirahama airport becomes hub airport, it will be prospected to enlarge its scale. For instance, it extends the operating time of the airport and establish runways and gates. In this study, the number of users of three model is given as the capacity of Nanki-shirahama airport.

(A) Chubu Centrair International Airport
It has as many runaways as Nanki-shirahama airport but more gates.

(B) Kansai International Airport
This is the highest number of domestic flight users.

(C) Tokyo International Airport (Haneda Airport)
This is the highest number of domestic flight users.

By using these models, the flight network and the number of passengers are predicted. About aircraft, A320-200 with the seating capacity of 180 is used all air routes[4]. In addition, it is constrained to the number of flights and we set 83 all airports in Japan for airport options that have probability to connect to hub airport[5].
As a result, when we set current status of Nanki-shirahama airport as a model, only one airport was connected and it got 180 passengers per day. On the other hand, in case of using Chubu Centrair International Airport as a model, it connected to 9 airports and got 15,480 passengers per day. In case of using Kansai International Airport as a model, it connected to 7 airports and got 11,880 passengers per day. Finally, in case of using Tokyo International Airport as a model, it connected to 51 airports and got 91,260 passengers per day. That is to say, when the Nanki-shirahama airport becomes the highest number of domestic flight users, it will be able to get 507 times of the current passengers.

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