Automation and Machine Learning (2023)
Clausius Scientific Press, Canada

DOI: 10.23977/autml.2023.040209
ISSN 2516-5003 Vol. 4 Num. 2

Visual Simulation of Interactive Information of Robot Operation Interface

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Keywords: Robot Operation, Operation Interface, Interactive Information, Visual Simulation

Abstract: At present, the robot operation information interface is faced with many unreasonable parts, such as the slow processing speed of the interaction information of the operation interface and the low accuracy of robot control. In view of this phenomenon, a visual simulation study on the interaction information of the robot operation interface is proposed. There is interactive information in man-machine operation interface, including manipulating objects and information points, integrating interactive information units, using knowledge element to process interactive information in robot operation interface to obtain information fusion set, and processing and processing interactive information. The information fusion set collected the basic information of the operator in many aspects, calculated the basic elements of the measurement information, calculated the entropy value by the algorithm, combined with different weight values, and calculated the fusion value comprehensively by adding the weighted values. After the weighted weight processing value into the controller for calculation, calculation of various deviations, omit the value and supplementary items, adjust all parameters to control the robot. And according to the real-time situation of robot operation interface interaction information, constantly adjust various parameters to adapt to new scenes. This paper studies the principle and content of visual simulation of interactive information of robot operation interface, and expounds the outstanding performance of visual simulation of interactive information of robot operation interface to improve the convenience of interaction. The data show that the interactive information visualization simulation of robot operation interface has significant results in visualization and high control accuracy.

1. Introduction

Interface programming is an important part of robot interactive information visualization. According to the scene changes, the scene is programmed and visualized. In the process of scene visualization, the software will be constantly updated and displayed on the screen, so that the real-time scene of programming will be displayed in a convenient and simple way. In the background of more and more mature programming technology, the visual application of the scene is constantly expanding. The research of visual simulation based on interactive information of robot operation interface solves the problem of interactive information, improves the visualization efficiency of programming language, promotes the improvement of robot control accuracy, and plays an increasingly important role in the field of intelligence.

On the research of visual simulation, many scholars at home and abroad have studied it. In foreign studies, Maksimenko O L proposed the internal characteristics and root of screen text as a visual simulation of reality, and its expression, symbol separation and structure share the same general semiotics and linguistic semiotics as general text. However, it is a multi-component system. Among its features, it is possible to distinguish between heterogeneity and ambiguity, making it an audiovisual reflection or, more precisely, a simulation of reality [1]. Sanjoyo B A proposed A stable visualization simulation algorithm for dam break flow. The Lax-Friedrichs scheme is chosen as the numerical method to solve SWE. Then, the consistency, stability and convergence of the scheme are studied. Finally, the strategy is transformed into a visual simulation algorithm of SWE, and its complexity is analyzed [2]. Osadskaya A proposed sim-UML system for the creation of additional visual and simulation models of professional education processes. This system can be used for labor cost estimation of manual and automated versions, and in practice is used to evaluate the labor cost of teachers to create additional professional education programs [3].

Visual simulation of interactive information of robot operation interface improves the level of technology research and development in the field of robotics, promotes the technical connection between interactive information of robot and visual simulation, and makes robot action and visualization fully intelligent docking. This set of technologies has profoundly promoted the innovation and development of robots and promoted the progress of human intelligence [4].

2. Design and Exploration of Visual Simulation of Interactive Information of Robot Operation Interface

2.1 Visual Simulation

Information visualization refers to the use of computer tools, the use of information interactive vision technology, the abstract transaction in a visual intuitive way to show, so as to improve cognitive ability. The purpose of information visualization is to produce a set of solutions to a problem. In this way, information needs to be processed and displayed in an intuitive and visual way through computer technology. In general, it relies on technology to create a set of intelligent robot information processing methods [5].

2.1.1 Interaction Design

The results of information interaction in information visualization have a significant impact on the viewer's vision. Interaction design includes two ways, the first digital self-interaction, the second human-computer interaction. More important is human-computer interaction. Its goals are twofold: first, usability; Second user experience. Usability is more about function, human-computer interaction is more about experience [6].

2.1.2 Interaction Design in Information Visualization

Information visualization has two steps, the first use of data according to a certain algorithm into images; Second, man-machine interaction, through man-machine interaction to extract communication information. The first step of information visualization interaction is to screen the original data, transform the data, and apply the data to visual transformation and the whole process of user processing. The following points should be noted:

1) Screening the original data

The huge amount of information will directly affect the user experience. Considering the purpose of human-computer interaction design, only the parts with expressive significance are selected here, and the methods are retained for selection and screening of original data. From data to visual representation is essentially the process of data processing, from abstract form to concrete representation is the efficient use of space, that is, how to display intuitive and infinite visual information in a limited environment. Take Backchannel, which intercepts real-time IRC communications. In this chat environment, the content is rich. Now 500 cases are extracted. When the software user selects the object, the picture of the selected object will be circled by color, and the one that is not selected will not change color [7-8].

2) Look for visual representations that fit the user's mental model

Users tend to be interested in data or models that fit their minds, and developers often give their products innovative visuals. If a Google developer develops a search location map, the system will map the user's search scene to the map one by one. Mark users and numbers on the map. All ICONS can form a population distribution.

2.2 Visual Simulation of Interactive Information of Robot Operation Interface

Visual simulation of interactive information of robot operation interface should be carried out from the following points, as shown in Figure 1:

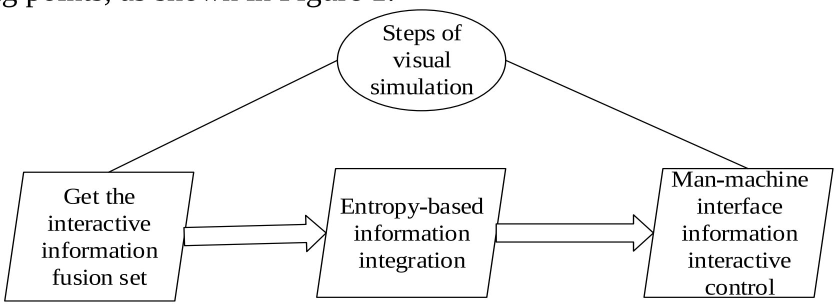

Figure 1: Man-machine interface information interaction control step diagram

The first step is to obtain the fusion set of interactive information.

Under the popular situation of robot interactive information visualization, the efficiency of visualization operation is improved, and the operation input is less. Knowledge element is used to obtain the objects and information sources of human-machine interface.

The second step is information integration based on entropy

Information entropy refers to the uncertainty in interactive information, which occurs in various fields. Information theory usually relies on computers to process information. As a medium of human-computer interaction, information is often used in software measurement programs, while information entropy is used in disordered programs of software measurement. The information processing needs to deal with the entropy value, adjust the weight of parameters, and clear the artificial influence in the information. Entropy value defines the uncertainty of information. Therefore, the greater the uncertainty of information, the higher the information content and the greater the weight value [9].

The third step, man-machine interface information interactive control.

PID controller is an intermediate control system between the robot and the operator. This system adjusts the proportion, adjusts the integral, and adjusts the differential control regularly. It can control the unstable man-machine information according to the error and analyze and control the man-machine optimization behavior, so as to carry out intelligent control.

3. Explore the Visual Simulation Effect of Interactive Information of Robot Operation Interface

This part carries out visual simulation of interactive information of robot operation interface by referring to the three steps in Section 2.2:

The first step is to obtain the fusion set of interactive information.

Assume that the robot interface interaction information hides N groups of the same information blocks, namely, the objects to be fused, called $k_{oi}(i=1,2,...,n)$; There are M group connectivity attributes in the information block, called attribute set, called $k_{aj}^{oi}(j=1,2,...,m)$; The information block contains P connectivity information sources, called $k_{sk}(k=1,2,...p)$. The formula k_{oi}, k_{aj}^{oi},i k_{sk} involved is as follows:

$$k_{oi}=(N_{oi},A_{oi},R_{oi}) \tag{1}$$

$$k_{aj}^{oi}=\left(p_{aj}^{oi},u_{aj}^{oi},f_{aj}^{oi},C_{aj}^{oi}\right) \tag{2}$$

$$k_{sk}=(N_{sk},A_{sk},R_{sk}) \tag{3}$$

According to the above calculation form, OI refers to the information block, namely the object to be fused. N_{oi}, A_{oi}, R_{oi} Refers to the name set, attribute set, and association set of the object OI to be fused. k_{aj}^{oi} Is the AJ attribute of the object OI to be fused; p_{aj}^{oi} refers to the characteristic description of AJ attributes by oi of the object to be fused, which is mainly about various measurement standards of the object to be fused. u_{aj}^{oi} is the measure of the AJ attribute; f_{aj}^{oi} is the expression of aj property change; Where $C_{aj}^{oi}\in\{C+,C-\}$, C+ refers to the security and economic performance of the object to be fused, and C- refers to the time loss and cost prediction of the object to be fused. Sk refers to the source of information, N_{sk} the definition and name collection of SK; R_{sk} is a collection of sk attributes; IU_{sk}^{oi} is the set of various connectivity of SK. The information unit is expressed as, and the expression is:

$$IU_{sk}^{oi}=\left(d_{jk}^{oi}\right) \tag{4}$$

Where, d_{jk}^{oi} represents the knowledge element, and refers to the value of aj corresponding to the object OI obtained by SK.

The second step is information integration based on entropy.

The global fusion weight obtained through calculation is W_{k}^{s}, for the local fusion result of processing information and the global fusion result of linear weighted processing information Z, the formula is:

The corresponding formula is as follows:

$$Z = \sum_{k=1}^{p} w_k^s z_k \tag{5}$$

The third step, man-machine interface information interactive control.

It is assumed that the control feedback result is C (Z), the deviation of the quantity to be controlled is e, the deviation rate of change e_c, k_p, k_i and k_d are all controller parameters, and the controller control calculation formula is based on the obtained controller parameters

$$C(Z) = \left(k_p e + k_i e + k_d e_c\right)\sum_{k=1}^{p} w_k^s z_k \tag{6}$$

4. Investigation and Analysis of Visual Simulation of Interactive Information of Robot Operation Interface

Environment tools: C language is selected as the computer processing language for customization. The parameter configuration of platform equipment is Window10 system, equipped with dual-core processor 5.9GHz, processor storage 128GB, ROM cache 2GB.

Note: Dragging teaching test is mainly carried out in the dragging teaching module of teaching interactive software [10]. After connecting the teaching device and the controller through Ethernet, algorithm compensation is carried out according to the force information feedback from the six-dimensional force sensor to complete dragging teaching.

When dragging teaching is implemented according to the active compliance algorithm, the robot's compliance is affected by the three parameters F, R and P. In order to more appropriately select reasonable parameters for dragging teaching experiment, data simulation should be carried out according to the model in the control system. After obtaining the simulation data, the operator can complete the performance verification in the dragging teaching process by inputting appropriate values, as shown in figure 2, 3. The abscissa represents the time of visual interaction of the robot (s), and the ordinate represents the intensity of visual interaction of the robot (N).

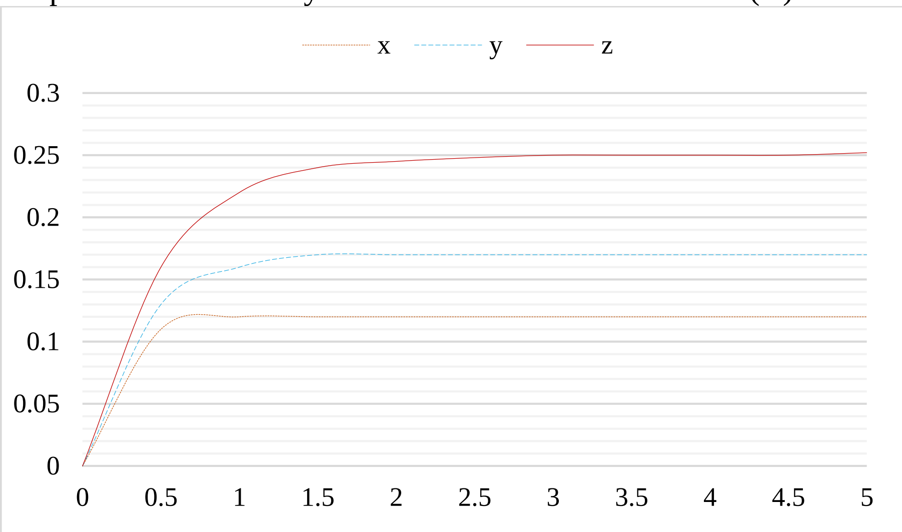

Figure 2: Change in F

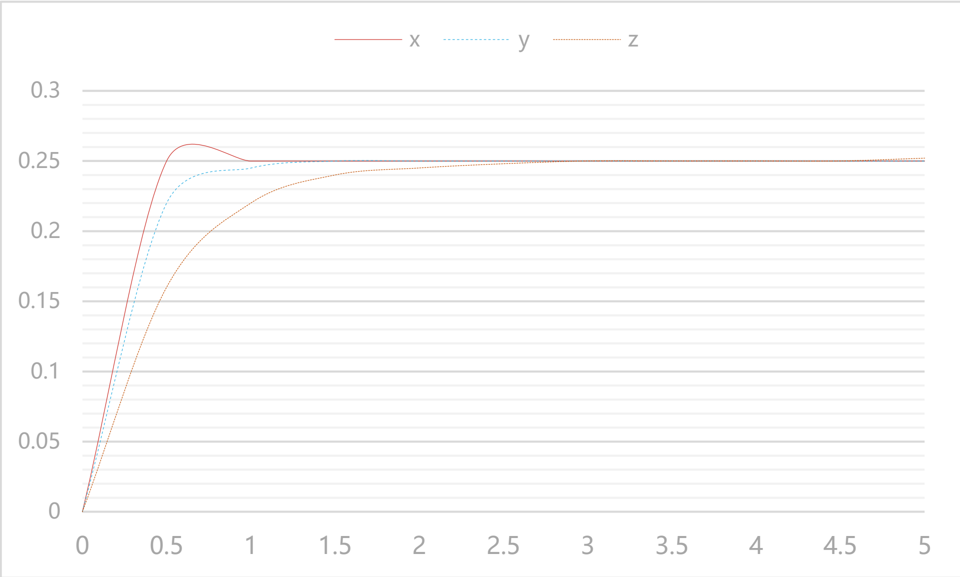

Figure 3: Change in R

1) When R and P remain unchanged, changing the size of F value will directly affect the size of the force applied in the dragging process.

In a certain range, the greater the F value, the greater the force required.

2) When F and P remain unchanged, changing the size of R value will determine the response speed of the robot in the dragging teaching process

How fast. In a certain range, the higher the R value, the slower the response.

Table 1: Comparison of drag schemes

plan	disadvantages	advantages
Based on the end torque sensor	Not very flexible	Good efficiency
Based on torque sensor	Not very flexible	Good efficiency
Impedance based torque free sensor now	Not very flexible	Good efficiency
Force-free sensor based on torque balance implementation	Not very flexible	Good efficiency

As shown in Table 1, the first line of the table represents plans, disadvantages and advantages. Several representative dragging teaching schemes are selected, such as 4 in Table 1. Respectively based on the end torque sensor (based on the end torque sensor), based on the connection point torque sensor (based on the torque sensor), Torque free sensor Now Based on impedance and force-free sensor Based on torque balance implementation All of these schemes have disadvantages and advantages, and all of them have similar characteristics. The disadvantages are low flexibility and high efficiency [11-12].

As can be seen from the data results in the table above, the interactive information visualization simulation of robot operation interface is well matched with the example of robot interaction information and visual simulation, and the interactive information and visual simulation can be seamlessly connected.

5. Conclusions

The development of information technology has profoundly changed the way of life and work of human beings. The use of multimedia technology can realize the interaction between the robot and the operator, improve the work efficiency, simple work form. The knowledge meta-model is used to calculate the relevant parameters and factors of the information unit, and finally obtain the information fusion set. In combination with various parameters of the model, the range control of the model is adjusted, and the subjective disturbance of the data model is minimized to improve the control accuracy of the robot [13-14]. For now the defect of information control interface, interface interaction information visualization simulation robot control method, this method can effectively improve the efficiency of the robot interaction information processing, enhance control precision of the robot for the robot operating visual simulation provides a reliable technical support, to made a significant contribution to the field of human-computer interaction[15].

References

[1] Maksimenko O L, Evgrafova Y A. Inherent Features and the Root Process of the Screen Text as the Audio- Visual Simulation of Reality. Concept Philosophy Religion Culture, 2020, 4(4):46-56.

[2] Sanjoyo B A, Hariadi M, Purnomo M H. Stable Algorithm Based On Lax-Friedrichs Scheme for Visual Simulation of Shallow Water. EMITTER International Journal of Engineering Technology, 2020, 8(1):19-34.

[3] Yu M, Osadskaya A, Shcherbakov S. Methodological Support of Additional Professional Education: Simulation and Labor Costs Estimation. Bulletin of Science and Practice, 2021, 7(1):340-349.

[4] Guevremont M, Hammad A. Ontology for Linking Delay Claims with 4D Simulation to Analyze Effects-Causes and Responsibilities. Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, 2021, 13(4): 04521024-04521024.

[5] Ahmed S Z, Jensen J, Weidner C A, et al. Quantum composer: A programmable quantum visualization and simulation tool for education and research. American Journal of Physics, 2021, 89(3):307-316.

[6] Kim D, Han S, Kim T, et al. Design of a Sensitive Balloon Sensor for Safe Human–Robot Interaction. Sensors, 2021, 21(6):2163-2163.

[7] Podpora M, Gardecki A, Beniak R, et al. Human Interaction Smart Subsystem—Extending Speech-Based Human-Robot Interaction Systems with an Implementation of External Smart Sensors. Sensors, 2020, 20(8):2376-2376.

[8] H Su, Lallo A D, Murphy R R, et al. Physical human–robot interaction for clinical care in infectious environments. Nature Machine Intelligence, 2021, 3(3):184-186.

[9] Asemi A, Ko A, Nowkarizi M. Intelligent libraries: a review on expert systems, artificial intelligence, and robot. Library Hi Tech, 2020, 26(June):1-23.

[10] Tao H, Rahman M A, Jing W, et al. Interaction modeling and classification scheme for augmenting the response accuracy of human-robot interaction systems. Work, 2021, 68(5):1-10.

[11] Iwasaki M, Ikeda M, Kawamura T, et al. State-Transition Modeling of Human–Robot Interaction for Easy Crowdsourced Robot Control. Sensors, 2020, 20(22):6529-6529.

[12] Permatasari D A, Fakhrurroja H, Machbub C. Human-Robot Interaction Based on Dialog Management Using Sentence Similarity Comparison Method. International Journal on Advanced Science Engineering and Information Technology, 2020, 10(5):1881-1881.

[13] Badr A A, Karim A. A Review on Voice-based Interface for Human-Robot Interaction. Iraqi Journal for Electrical and Electronic Engineering, 2020, 16(2):91-102.

[14] Hsieh W F, Sato-Shimokawara E, Yamaguchi T. Investigation of Robot Expression Style in Human-Robot Interaction. Journal of Robotics and Mechatronics, 2020, 32(1):224-235.

[15] Romano D, Bloemberg J, Tannous M, et al. Impact of Aging and Cognitive Mechanisms on High-Speed Motor Activation Patterns: Evidence From an Orthoptera-Robot Interaction. IEEE Transactions on Medical Robotics and Bionics, 2020, 2(2):292-296.