ORIGINAL ARTICLE

Integrated Poser+MATLAB Environment to Enhance Virtual Reality Toolbox Capabilities for Bio-System 3D Animations

Fereidoun Nowshiravan Rahatabad [1*], Seyyed Kasra Mortazavi [2]

[1] *Department of Biomedical Engineering, Science and Research Branch, Islamic Azad University, Tehran, Iran*

[2] *Department of Electrical Engineering, Amirkabir University of Technology, Tehran, Iran*

*Corresponding Author: Fereidoun Nowshiravan Rahatabad
Email: nooshiravan@gmail.com

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Abstract

Purpose: Although MATLAB is a powerful math program, its virtual reality (VR) toolbox is limited for those who engage in the modelling of human body systems. The integration of Poser software with MATLAB is provided in this study for designing and developing human bodies in VR.

Materials and Methods: First, a human entire body model was created in the Poser environment. The prototype is then loaded into MATLAB Simulink.

Results: Two-Link Arm powered by Six Muscles (TLASM), a well-known model of human arm movements in the horizontal plane, is simulated to test the efficiency of the virtual model. TLASM was presented in this team's prior work.

Conclusion: Despite the fact that only one limb of the human virtual platform body has been tested, it can easily be applied to other limbs.

Keywords: Human Body Modelling; Upper Limb; Virtual Reality; Poser; MATLAB.

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1. Introduction

Virtual Reality (VR) is currently taking center stage in scientific research, telemedicine, and education [1, 2]. This field can be used to create and construct Functional Electrical Stimulation (FES) systems to help the disabled [3, 4], tele-rehabilitation [5-7], human muscle-skeletal system modeling, surgical simulators [8], and telepresence surgery [9-12], as well as prostheses design [13].

A large number of academics prefer to use the MATLAB VR Toolbox over other options. In a 3-D VR environment, VR allows users to see and interact with dynamic system models. The toolbox connects MATLAB and Simulink to VR graphics, allowing them to manipulate the position and rotation of 3-D images created in the VR environment. The human body figure is missing from the MATLAB VR toolbox. Since MATLAB's V-Realm Builder includes fundamental design capabilities, researchers looking for Computer-Aided Design (CAD) systems. There are various software tools available for creating 3D visual virtual models, including AutoCAD, Proingeneer, and Archicad, as well as Solid works and Maya. These graphic software are sophisticated CAD tools for developing system parts, but they are not suited for modeling the human body and anatomical structures, or they do not have simple MATLAB implementations (i.e. Adams + Life mode). Then we utilized Poser, a 3D animation software application that is specifically designed for models that show the human figure in three dimensions. Because of simplicity in use, the application has become highly popular. It can export 3D objects in the MATLAB-compatible Virtual Reality Modeling Language (VRML) format.

The primary objective of this article is to include the human body in the MATLAB VR environment. Poser is used to create the human body model. The visual was then imported into MATLAB's V-Realm Builder, where some changes were made. Two-Link Arm powered by Six Muscles (TLASM), which is said to represent the human arm model in the horizontal plane, is evaluated to assess the capabilities of the human virtual model [1, 14]. Poser Platform Benefits and Capabilities for Body Simulation and Sports Modeling Simulation [15]. Poser provides the power of interactive 3D figure design, providing infinite opportunities to portray human diversity, form, and expression through the use of light in the design.

Poser is a type of model which is created with the human form for art, illustration, animation, education, and medicine, among other things; an abundance of data as well as an up-to-date database that is easily accessible via the internet.

We can highlight the application of numerous alterations in the created structure, which can be entered and used in the design directly, as one of Poser's characteristics.

Poser Simulator allows data entry from other 3D design software such as 3DS- Max, Mayaz, Light wave and C4D. Poster output can also be uploaded in this software's. Poser output can be in the form of a quiet image, an Audio Video Interleave (AVI) file, a flash animated cartoon, or a live 3-D model. The output function can be exported to the network through Viewpoint Media Player. Because the software environment has a simple structure, it is incredibly user-friendly. It is also appropriate for use on a semi-professional Personal Computer (PC). The most significant benefit of this software is its low cost. The image's high resolution and the ability to apply natural conditions to the intended structure aid in the creation of a design that is very comparable to the original sample.

2. Materials and Methods

2.1. Creating VR Model from Poser Software

Poser 7.0 was used to create the prototype models used in this paper. Poser is a 3D figure design and animation program that allows artists and animators to build 3D scenarios using a wide range of ready-to-use 3D human and animal models [16]. It has an intuitive interface and one can realistically customize his/her figures and scenes elaborately. This software lets us export objects in many formats, especially VRML. In VR software such as MATLAB, the VRML file format can be used. For our work, we use SimonG2's body model (Figure 1). Poser uses a large database of scanned human parts that its hair, cloth, material, and face can be changed.

2.2. Using the V-Realm Builder to Modify the Feature of the VR Model

To modify the CAD packages, the Poser model is imported to V-Realm Builder on the MATLAB platforms. V-Realm Builder is a versatile VRML program that provides a proper VRML syntax interface. It also allows

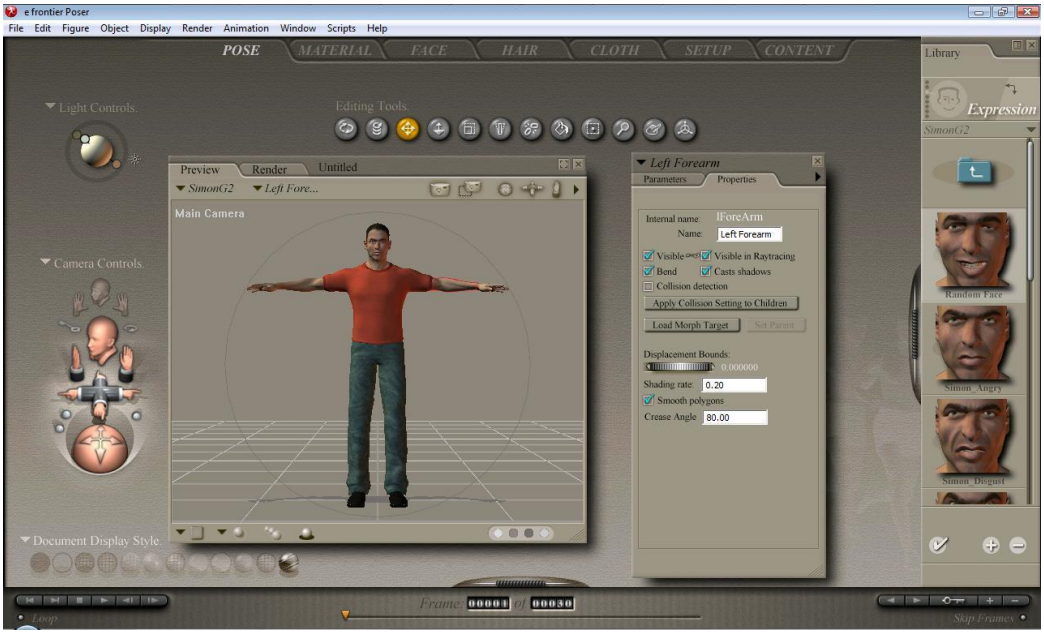

Figure 1. The human template model from poser-simong2

you to define nodes in a hierarchical tree-style view (tree viewer) of all the items in the model.

Nodes, such as joints and connections, are structurally changing components of the human model. Figure 2 shows the V-Realm Builder 2.0 captured screen, which includes all perspectives of the VRML model of a human arm. The VRML model is now ready to use with the MATLAB VR Toolbox after you have made the necessary adjustments.

2.3. Integration of VR Model with Simulink Model

The "VR Sink" block is called once the MATLAB Simulink window has been opened. The VRML model that was previously produced is then loaded. Some settings must be changed, as shown in Figure 3. Rotation and translation of model components are these parameters. The integration of the visual representation of the mechanism with the Simmechanics blocks is finished after ticking the appropriate boxes.

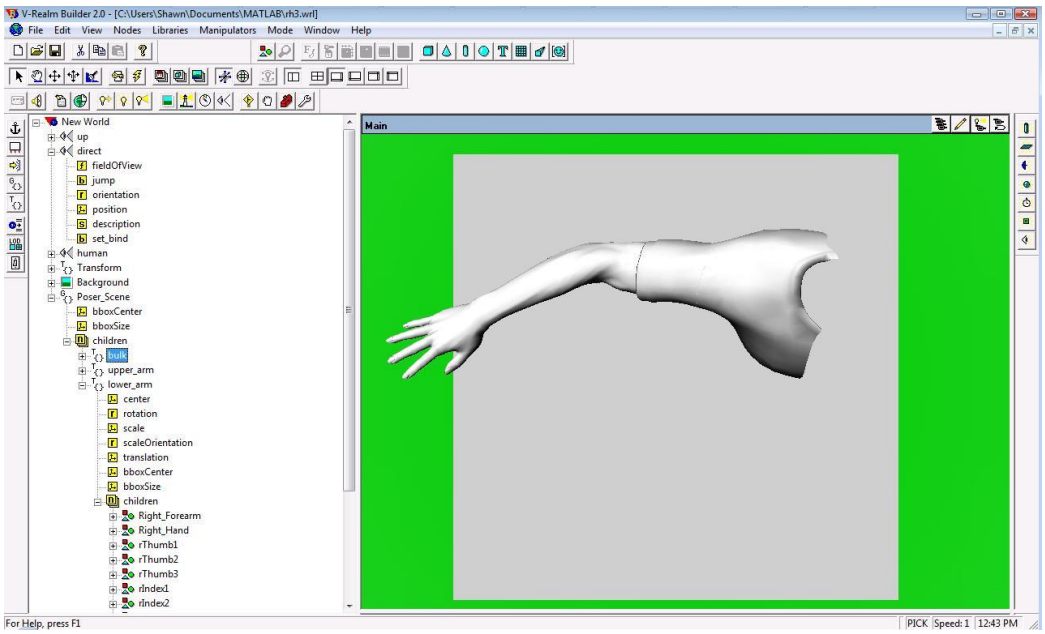

Figure 2. The VRML model of the human arm in V-Realm builder

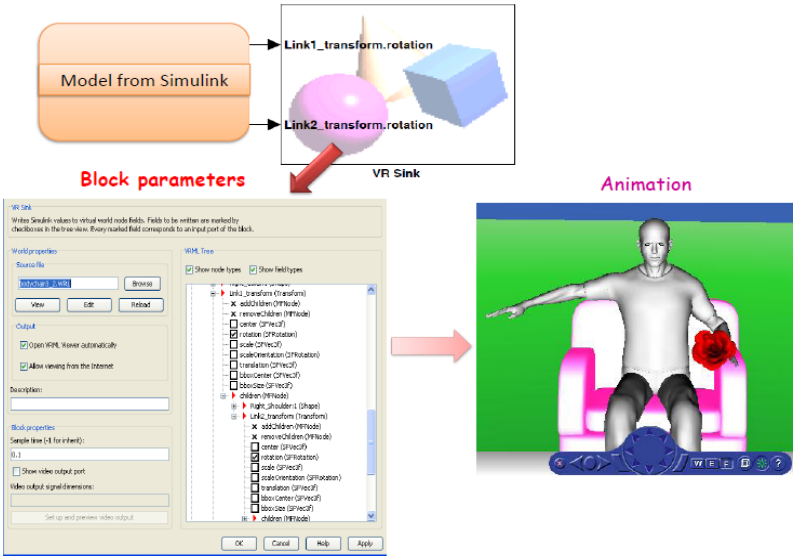

Figure3. VR sink block parameter window

2.4. Testing the Proposed VR Model for a Specific Limb Movement

We use the human arm model movement to demonstrate the possibilities of the suggested approach [17,18]. The sensory-motor control system of the human arm in reaching motions is studied in this simplified model. They invested in a two-link planar arm model with six redundant muscles in humanlike quasi-straight line reaching movements. The outputs of the model are the joint angels of the shoulder and elbow.

3. Results

Figure 3 depicts the entire mechanism. The system is made up of two blocks: the first generates planar arm movement, and the second is the VR-sink module. Figure 4 depicts the animation as a result of different view angles. The overall movement generated from the simulation is demonstrated in Figure 5.

In terms of the VRML model's use in the Muscular Skeletal Motor Control course, we upload the files in https://noushiravanmortazavivirtualreality.blogsky.com for further use.

4. Conclusion

The ultimate focus of this work is to create a virtual human body for usage with MATLAB software. Poser 7.0 was used to create the human virtual model. Then the model is modified in V-Realm builder of MATLAB and called by VR toolbox of MATLAB. Two link arms powered by six muscles explored by [15, 19] are utilized to evaluate the virtual model. This model has 33 joints and 12 connections and is a tree hierarchical model. This model may be used to adorn a variety of movement models defined by MATLAB mfiles/Simulink workstation. Besides, it would be useful for animating three-dimensional displays and testing human whole-body models. The advantage of this method over others (CAD tools) is that we already have a well-prepared human body database in Poser 7.0, as well as easy interface with MATLAB.

This VRML model is now available in https://noushiravanmortazavivirtualreality.blogsky.com. It has been utilized for two semesters in a Muscular Skeletal Motor Control course. Other human component models will be used to the virtual human body in the future. Furthermore, we would like to use the virtual human model to create prosthetics and orthesis to assist disabled and handicapped people.

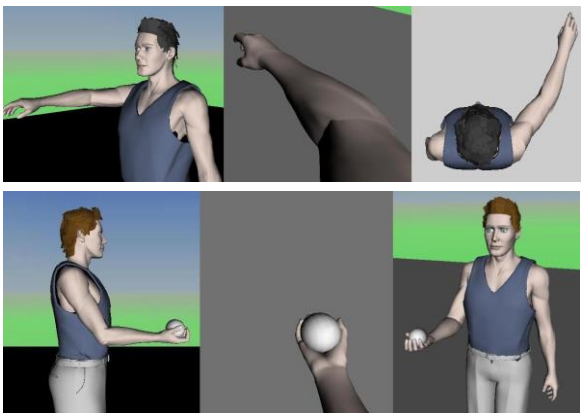

Figure 5. The overall graphical image movement generated from simulation

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