BU STUDENTSHIPS 2015

PROJECT DESCRIPTION

PROJECT DETAILS

Project Title

Motion Design for Injured Characters in Computer Games

Project Summary

With the recent advancement of computer animation technology, computer games is becoming one of the fastest growing industries. It is reported that 1,902 games companies in UK contribute to UK economy £1.7 billion in 2014. The huge market size and 7% growth rate are making the computer games industry a significant economic sector. As the development of different game genres such as first person shooter, action games, sports games, the simulation of virtual character movement has become a necessity for most of the games. Various fighting and stunt motions frequently appear. Virtual characters can easily become injured and they need to keep performing with such "unhealthy status" in the subsequent scenes. Most of current motion-animation technology used in industry is based on the assumption of a normal healthy subject. Few research on the motion design of injured character are reported.

Motion capture and tracking techniques has been an industry standard for computer games for many years. However the quality of the final motion depends heavily on the performance and acting skills of the actors. It is very difficult for actors to perform injured motion, especially when the actors do not have such special experience, or a live injured example for copying is not available. Physically based motion simulation have been proposed to meet the challenge once the action can not be captured by MOCAP system, e.g. some dangerous stunt actions. Based on the research from robotics, researchers have designed the "muscle-skeleton-skin" three layers character model to simulate character animation. However, for a whole character body, the whole system is very complicated, it is very difficult for animators to tune the motions of each individual muscles consistently to produce a realistic whole body motion. Inspired by the research of neurology and biomechanics, we would like to propose a four layer "neural-muscle-skeleton-skin" control system. The unhealthy status could be interpreted as various insufficient stimulus signal as control for neural system. A high level semantic control will be developed to drive the muscles with the neural signals.

The Central Nervous System is the natural control for the muscles to perform actions. In collaboration with Dr. Rupert Page (Consultant Neurologist in Dorset), a prototype of the 3D avatar of CNS and control system will be developed. Due to the complexity of CNS, a data driven based simulation model will be developed to study the neural system's effect on muscle controlling. The training data of CNS status and corresponding motion will be supplied by our hospital partners.

Following this four layers system, animators only need to identify semantically the unhealthy condition of the virtual characters. The system will work out the related neural signal controls automatically and generate whole body motions through physically based simulation. The animator will be facing a more intuitive and friendly interface for animation production. We anticipate it would short the whole process of motion design and increase the reality of character animation.

Academic Impact

The research idea was stemmed from the joint research project "NeurAvatar" between the NCCA and Pool Hospital. The success of this project will further strengthen their relationship and lead to longer term and larger scale collaborations.

A dataset and a prototype of CNS system will be developed and published.

A "neural-muscle-skeleton-skin" biomechanical model for character animation will be constructed. The correspondence between muscles and neural will be identified in collaboration with Dr. Rupert Page. The training

data would be collected anonymously by our partner to develop a data-driven model to simulate the actions of injured/unhealthy character.

All the researchers related to the creative industry, including character animation, computer games and social agents will benefit from the research output of this project.

The research output will be published on peer-reviewed leading journals and international conferences, which will contribute to the next REF. A project website will be set up. News, achievements and activities will be broadcast timely on the website increasing the public awareness of the project.

Societal Impact

The direct beneficiary of this proposed research will be on two aspects:

The clinical prototype of the avatar will benefit neurology diagnosis and research. The developed system will be applied in Pool Hospital, the centre for neurology in Dorset. It will provide convenience for understanding neurological symptoms, which will be helpful for the current scarcer of Neurologist (around 1 per 115,000 for UK, less than 1 per 187,500 in Dorset). Moreover, the expected reduction of admission conversion rate will save the NHS cost for Dorset annually. For instance, based on current data from Poole Hospital, a modest reduction of 5% in the rate of conversion to admission would be expected to return more than £70,000 in cost savings solely for Dorset annually.

The second one is the creative industry including computer games and featured films. The developed techniques will be implemented as plugins and models for the animation software Autodesk Maya. The success of this project is likely to change the working pattern of the animators in games and film industry. They will then be able to easily design and control special motions for injured characters.

Generally, it will be a success of collaboration across areas and provide a “double-win” result.

Training Opportunities

Apart from the day-by-day support from the supervision team, the student will receive full Ph.D. training during the project. Since this project involves three different research directions, Computer Animation, Neurology and Data Science, NCCA and Poole Hospital will provide proper training opportunities on the following topics to help the student to acquire the essential knowledge and skills:

1) CNS system knowledge

2) Motion capture, motion graph and motion synthesis

3) Maya scripting and OpenGL programming

4) Mathematics for computer graphics

The training will be achieved through attending relevant lectures, workshops and seminars. Based on the rich links of the NCCA with the creative industry, necessary industry internship will also be organised.

Training of communication skills (presentations at conferences, seminars, etc.) and writing academic papers will also be arranged by the supervision team. Attendance of the Graduate School’s extensive training courses such as new researchers workshops will also help the student to develop his/her research career.

SUPERVISORY TEAM	
First Supervisor	Xiaosong Yang
Additional Supervisors	Jian Jun Zhang
Recent publications by supervisors relevant to this project	Wang, Z., Feng, Y., Qi, T., Yang, X., Zhang, J., 2015, Adaptive multi-view feature selection for human motion retrieval, Signal Processing (accepted) Feng. Y., Ji, M., Xiao, J., Yang, X., Zhang, J., Zhuang, Y., Li, X., 2015, Mining Spatial-Temporal Patterns and Structural Sparsity for Human Motion Data

Denoising, Cybernetics, IEEE Transactions on. (Accepted)

Qi, T., Feng, Y., Xiao, J., Zhang, H., Zhuang, Y., Yang, X., Zhang, J., A human motion feature based on semi-supervised learning of GMM, Multimedia Systems (2014) 1–9. (Accepted and Published online firstly)

Xiao, J., Feng, Y., Ji, M., Yang, X., Zhang, J., Zhuang, Y., 2014, Sparse Motion Bases Selection for Human Motion Denoising, Singal Processing, accepted, DOI: 10.1016/j.sigpro.2014.08.017.

Qi, T., Xiao, J., Zhuang, Y., Zhang, H., Yang, X., Zhang, J., Real-time motion data annotation via action string, 2014, Computer Animation and Virtual Worlds, accepted, DOI: 10.1002/cav.1590

Tang, Z., Xiao, J., Feng, Y., Yang, X., Zhang, J., Human Motion retrieval based on freehand sketch, 2014, Computer Animation and Virtual Worlds, accepted, DOI: 10.1002/cav.1602

Feng, Y., Xiao, J., Zhuang, Y., Ji, M., Yang, X., Zhang, J., Song, R., Exploiting temporal stability and low-rank structure for motion capture data refinement. 2014. Information Science, accepted.

Pan, J. J., Chang, J., Yang, X., Liang, H., Zhang, J. J., Qureshi, T., Hickish, T. Virtual reality training and assessment in laparoscopic rectum surgery, 2014, The International Journal of Medical Robotics and Computer Assisted Surgery, accepted.

Qi, T., Feng Y., Xiao J., Zhuang Y., Yang X., Zhang J.J., A Semantic Feature for Human Motion Retrieval, 2013, Computer Animation and Virtual Worlds, Volume 24, Issue 3-4, pages 399–407, DOI: 10.1002/cav.1505.

Liu, F.D., Southern R., Guo S.H., Yang X.S., Zhang, J.J., Motion Adaptation With Motor Invariant Theory, 2012, IEEE Transactions on Systems, Man and Cybernetics: Part B. Cybernetics, Volume: PP, Issue: 99, Page(s): 1-15, November 2012, doi:10.1109/TSMCB.2012.2224920,

Yang, X.S., Chang, J., Southern, R., and Zhang, J. J., 2012, Automatic Cage Construction for Retargeted Muscle Fitting, The Visual Computer, DOI: 10.1007/s00371-012-0739-3

You, L.H., Yang, X.S., You, X. Y., Jin, X., Zhang, J. J., 2010. Shape manipulation using physically based wire deformations. Computer Animation and Virtual Worlds. 21(3-4), 297-309

Yang, X.S., Chang, J., Zhang, J.J., 2007. Animating the Human Muscle Structure. Computing in Science & Engineering, 9(5), 39-45.

Zhang, J.J., Yang, X.S., Zhao, Y.F., 2007. Bar-net driven skinning for character animation. Computer Animation and Virtual Worlds, 18(4-5), 437-446.

Yang, X.S., Zhang, J.J., 2006. Automatic Muscle Generation for Character Skin Deformation. Computer Animation and Virtual Worlds, Volume 17, 293-303.

Yang, X.S., Somasekharan, A., Zhang, J.J., 2006. Curve Skeleton Skinning for Human and Creature Characters. Computer Animation and Virtual Worlds, Volume 17(3-4), 281-292.

INFORMAL ENQUIRIES
To discuss this opportunity further, please contact Xiaosong Yang via email: xyang@bournemouth.ac.uk
ELIGBILITY CRITERIA
All candidates must satisfy the University's minimum doctoral entry criteria for studentships of an honours degree at Upper Second Class (2:1) and/or an appropriate Masters degree. An IELTS (Academic) score of 6.5 minimum (or equivalent) is essential for candidates for whom English is not their first language.
HOW TO APPLY
Please complete the BU Research Degree Application 2015 and submit it via email to the Postgraduate Researcher for Admissions **Suzy Kempinski** - pgradmissions@bournemouth.ac.uk by **4 November 2015**. Further information on the application process can be found at www.bournemouth.ac.uk/phd-2015