

2022-05186 - PhD Position F/M Deep interactive control of virtual character's motion based on separating identity, motion and style (Inria/InterDigital Ys.ai project)

Type de contrat : CDD

Niveau de diplôme exigé : Bac + 5 ou équivalent

Fonction : Doctorant

A propos du centre ou de la direction fonctionnelle

The Inria Rennes - Bretagne Atlantique Centre is one of Inria's eight centres and has more than thirty research teams. The Inria Center is a major and recognized player in the field of digital sciences. It is at the heart of a rich R&D and innovation ecosystem: highly innovative SMEs, large industrial groups, competitiveness clusters, research and higher education players, laboratories of excellence, technological research institute, etc.

Contexte et atouts du poste

Inria and InterDigital recently launched the Nemo.ai lab dedicated to research on Artificial Intelligence (AI) for the e-society. Within this collaborative framework, we recently initiated the Ys.ai project which focuses on representation formats for digital avatars and their behavior in a digital and responsive environment, and are looking for several PhDs and post-docs to work on the user representation within the future metaverse.

This PhD position will focus on exploring, proposing and evaluating novel solutions to represent both body shape and movements in a compact latent representation. This representation aims at simplifying the adaptation of the shape (identity) of a user, or/and his motion, and/or the style of both his shape and motion (such as transferring the user's moving shape to a fictional character with different properties and style).

Mission confiée

For its current and future standard video and immersive activities, Interdigital is aiming at providing semantic-based data solutions for videoconference and Metaverse applications. The goal is to stream data enabling the editability, controllability and interactivity of the content, while keeping the data throughput low to enable the use of existing and coming networks.

Character animation has a large set of potential applications, in videogames, movie industry, sports, rehabilitation, ergonomics, training, etc. To capture a 3D human shape in motion, two options are available at the moment: either a direct acquisition of the surface mesh thanks to a calibrated multi-camera setup, or a skinning technique from the animated skeleton. However, being able to capture and reproduce the expressivity of a human motion is difficult, as it involves several subtle parameters, some of them being lost when modeling human performance as joint angles: angles, contacts on the body surface, velocity profiles, accelerations, distance or coordination between body parts, etc. With the development of robust body shape reconstruction based on cheap sensors, such as RGB cameras or depth sensors, directly manipulating the visible surface of the character has become a very active field of research.

With the growing interest in persistent shared virtual worlds, such as the MetaVerse immersive social network, specific problems for character animation are raised. Indeed, in these environments, users are represented by avatars with different shapes and morphologies. Compared to the face, which has been studied for decades, there is no semantic controller for the body mesh, where one could easily change the motion type and style. The character animation platform should consequently be able to adapt the motion of the user to his/her specific shape (retargetting problem), or adapt the identity of the avatar so that the user is recognizable by his/her friends, or change the style of the motion to convey a given emotion or adapt to the expected behavior of the avatar. For example, a Hulk avatar is expected to move with a specific style, but should also mimic the characteristics of the user. Finally, the distribution of these avatar models over the network is a practical challenge due to the potential scale of the shared virtual worlds. Therefore, learning a representation that allows for efficient transmission and dynamic editing has a high practical impact.

Principales activités

Motion retargetting has been explored a long time ago, by satisfying hand-tuned constraints that the character has to preserve, and use inverse kinematics to adapt the joint angles accordingly [5]. Other works introduced the idea of Interaction Mesh to replace hand-tuned geometric constraints by automatically preserving distances between body joints [6]. However these methods do not take the body surface into account, whereas it conveys a lot of relevant information about the motion. Recent works suggested that transferring the pose from a source to a target character was an ill-defined problem [2]. Alternatively, they proposed to transfer the shape of the target character to the source character in its desired pose, while preserving his identity.

Other recent works using deep learning aimed at separating the identity and shape, especially in the RGB video space [1]. Other works obtained impressive results to change the style of a picture, to make a human seem older, change head orientation, or the color [4]. However this work is very difficult to transfer from 2D RGB videos to 3D shapes.

Identity transfer for mesh-based motion.

Recent works suggested that transferring the pose from a source to a target character was an ill-defined problem [3, 2]. Alternatively, they proposed to transfer the shape of the target character to the source character in its desired pose while preserving his identity, either using optimization [3] or deep learning approaches [2]. Unlike previous works such as adapting joint angle [5] or preserving

Informations générales

- **Thème/Domaine :** Interaction et visualisation
Plateformes expérimentales logiciel (BAP E)
- **Ville :** Rennes
- **Centre Inria :** Centre Inria de l'Université de Rennes
- **Date de prise de fonction souhaitée :** 2023-01-01
- **Durée de contrat :** 3 ans
- **Date limite pour postuler :** 2023-01-31

Contacts

- **Equipe Inria :** MIMETIC
- **Directeur de thèse :**
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A propos d'Inria

Inria est l'institut national de recherche dédié aux sciences et technologies du numérique. Il emploie 2600 personnes. Ses 200 équipes-projets agiles, en général communes avec des partenaires académiques, impliquent plus de 3500 scientifiques pour relever les défis du numérique, souvent à l'interface d'autres disciplines. L'institut fait appel à de nombreux talents dans plus d'une quarantaine de métiers différents. 900 personnels d'appui à la recherche et à l'innovation contribuent à faire émerger et grandir des projets scientifiques ou entrepreneuriaux qui impactent le monde. Inria travaille avec de nombreuses entreprises et a accompagné la création de plus de 180 start-up. L'institut s'efforce ainsi de répondre aux enjeux de la transformation numérique de la science, de la société et de l'économie.

L'essentiel pour réussir

The candidate should like working in a team, should be curious and propose ideas and solutions. Creativity, is also an interesting key to success in such a research project.

Consignes pour postuler

Please submit online : your resume, cover letter and letters of recommendation eventually

Sécurité défense :

Ce poste est susceptible d'être affecté dans une zone à régime restrictif (ZRR), telle que définie dans le décret n°2011-1425 relatif à la protection du potentiel scientifique et technique de la nation (PPST). L'autorisation d'accès à une zone est délivrée par le chef d'établissement, après avis ministériel favorable, tel que défini dans l'arrêté du 03 juillet 2012, relatif à la PPST. Un avis ministériel défavorable pour un poste affecté dans une ZRR aurait pour conséquence l'annulation du recrutement.

Politique de recrutement :

Dans le cadre de sa politique diversité, tous les postes Inria sont accessibles aux personnes en situation de handicap.

Attention : Les candidatures doivent être déposées en ligne sur le site Inria. Le traitement des candidatures adressées par d'autres canaux n'est pas garanti.

body joints distance [6], transferring the shape does take body surface into account, leading to the preservation of body contact. Unfortunately, these approaches are currently limited to static poses and therefore not directly suitable for character animation and style transfer in the Metaverse. A possible first research direction is to extend these state-of-the-art contact preserving retargeting methods to motion instead of isolated poses. Tackling the dynamics of the animation will require identifying dynamic user characteristics, extracting them from references and transferring identity while generating a temporally coherent animated mesh.

Efficient latent representation of identity, motion and style.

Metaverse is likely to involve cooperation between many entities. Hence, a huge volume of different environments, animations, characters, user identity and style must be shared and exchanged between entities. Creating or learning efficient and consistent representations of these items is necessary. There are two main deep learning based approaches to compress 3D data: implicit neural representations such as [7] and autoencoders such as [8, 9]. Unfortunately, it is usually hard to manipulate the encoding learned by these models to edit or transfer identity, motion or style. A solution could be to leverage and/or adapt recent advances in GAN inversion, where an encoder is trained to yield a latent space that can easily be manipulated [11]. Another possible direction is to enable acquisition of consistent embeddings on heterogeneous devices. One possible approach is to train neural networks with varying complexity [12].

Retargeting for other animations

Retargeting through identity transfer could be applied to other types of animation, such as skeleton or multi-body based animations. This would open up the possibility to use these animations techniques for Metaverse rendering. Recently, parametric controllers for multi-body that enables body shape variation have been proposed [10]. However, this approach currently lacks any mean to transfer identity. It could benefit from techniques similar to [3, 2]

The PhD will be co-supervised by:

- Franck Multon, Inria Rennes, MimeTIC team
- Pierre Hellier, InterDigital Rennes
- Adnane Boukhayma, Inria Rennes, MimeTIC team
- François Schnitzler, InterDigital Rennes

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References

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- [8] Maurice Quach, Giuseppe Valenzise, and Frederic Dufaux. Learning convolutional transforms for lossy point cloud geometry compression. In *2019 IEEE international conference on image processing (ICIP)*, pages 4320–4324. IEEE, 2019.
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- [12] Jiahui Yu, Linjie Yang, Ning Xu, Jianchao Yang, and Thomas Huang. Slimmable neural networks. In *International Conference on Learning Representations*, 2019.

Compétences

The candidate must have MSc in computer sciences, with a focus either on machine learning, computer graphics or on virtual reality. In addition, the candidate should be comfortable with as much following items as possible:

- Deep learning
- Development of 3D/VR applications (e.g. Unity3D) in C# or C++.
- Character simulation and animation
- Geometry processing
- Evaluation methods and controlled users studies.
- Computer graphics and physical simulation.

The candidate must have good communication skills, and be fluent in English.

Avantages

- Subsidized meals
- Partial reimbursement of public transport costs
- Possibility of teleworking (90 days per year) and flexible organization of working hours

- Partial payment of insurance costs

Rémunération

Monthly gross salary amounting to 1982 euros for the first and second years and 2085 euros for the third year