To MOVE4D, or Not to Move,That is the Question

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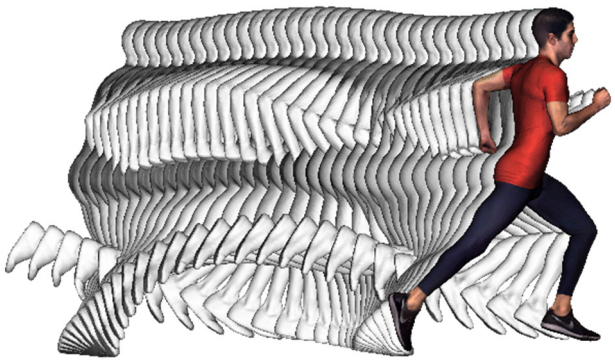

Figure 1: Example of MOVE4D go through running motion capture at 90 fps and High resolution

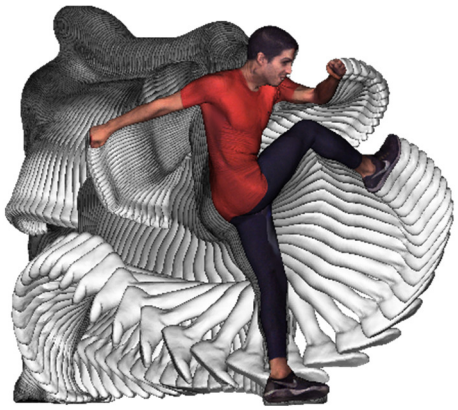

Figure 2: Example of MOVE4D free kick motion capture at 90 fps

Keywords: Digital anthropometry, temporal scanning, 4D, human motion, markerless, motion analysis, image processing, 3D body model, shape, pose, template-fitting algorithm, homologous mesh, deep learning, machine learning.

Extended Abstract

This presentation describes the key technical features of MOVE4D system and provides details about the type of outcomes that can be obtained using it. We also provide a few examples of the new features that will be included in the software in the next months as well some examples of the research and consultancy work that our research group is conducting using MOVE4D to farm data and apply deep learning and machine learning techniques.

MOVE4D is a modular photogrammetry-based 3D/4D capture and analysis system developed at IBV. The system can be configured to scan body parts or full bodies with texture. A typical full body configuration can provide a spatial resolution of 1mm.

MOVE4D modules capture shape and texture simultaneously. Each module captures shape with a pair of IR cameras and texture with an RGB camera. The fact of capturing shape and texture simultaneously, makes it possible to capture at high frequencies: up to 178 fps at medium resolution and up to 90 fps at high resolution. At maximum frame rates, the equipment is able to capture 55 seconds at mid resolution and 25 seconds at high resolution. Lighting elements can be added to the structure to obtain a more uniform texture and color.

The scanning volume in the basic 12-module configuration is 2x2x3m (length, width, height) and it can be extended in length by adding and repositioning the modules; for instance, with 16 modules you can get a scanning volume of 3x2x3m. The system is conceived to have plenty of space and a safe distance from the modules to the scanning volume to let the subjects perform high speed sports motions comfortably. The modules are deliberately placed in two rows to create a free lane to let you capture go-through movements. Despite that the Laboratory has a large footprint we can build the MOVE4D modules with higher angles of view to fit smaller spaces, bringing the columns closer to the scanning space. Sensors can either be mounted in columns or in walls. MOVE4D uses a wand calibration method. We chose this method because it makes it very easy and fast to get an accurate and robust calibration.

Another characteristic of MOVE4D that is critical for conducting research activities is that it can be synchronised with other measuring equipment. It is ready for three possibilities: trigger input, synchro input and synchro output. This enables data gathering, for instance, to develop new technologies based on deep learning from MOVE4D content paired to other biometric signals. But possibilities are endless and this laboratory can open new research lines that we cannot imagine today.

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Regarding the data outcomes, the unique feature of this laboratory is that MOVE4D software incorporates anthropometric and biomechanical data processing. What you obtain is a sequence of homologous meshes. A homologous mesh is a textured watertight mesh of 50 thousand vertices that is fitted to the captured point cloud using AI and proprietary template fitting software. This mesh has point-to-point correspondence along the sequence of frames and across different subjects. It is actually having 50 thousand landmarks on the body surface captured. A subset of these landmarks includes key anatomical references and lines. These organised datasets are therefore ready to be used in your research and development work. These 3D content can be exported in OBJ format. Moreover, at each frame, you can also obtain an estimate of 23 joint positions and a Linear Blend Skinning rig per frame that can be exported in FBX format. From A-Pose you can also obtain more than 100 standard static body measurements. Currently, this type of anthropometric and biomechanical processing is conceived to capture humans in tight garments and with fists closed according to standards. In addition to these, we can also provide the typical outcomes that can be provided by any 3D or 4D scanner, like dense point cloud capture or a non-organised mesh with holes.