Presenting a Deep Motion Blending Approach for Simulating Natural Reach Motions

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Motivation

- **Character animation** is an **essential** aspect for **many branches** such as gaming and automotive industry
- **Data driven motion blending** approaches are **commonly used** to derive natural motions
- However, these systems increasingly **fail** with **growing number** of **influence parameters** (e.g. person's height, self collision constraints)
- Due to **growing computational capabilities**, recently **deep learning based approaches** [1] received significant attention while producing promising results

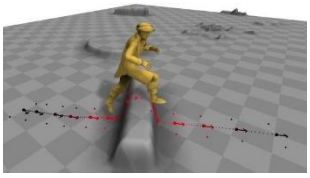

Figure 1: Phase functioned neural networks applied for locomotion [1]

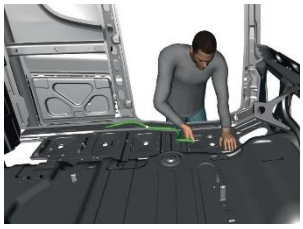

Figure 2: Character animation system used in automotive industry [2]

Proposed Approach

We propose a novel approach to **model human reach motions**, while considering multiple **influence parameters**. Our method **extends** the work of Holden et al. [1] in which the authors proposed **phase functioned neural networks** to model human walking behavior, to **arbitrary non-cyclical** motions:

- **Modelling** of **human reach motions** with several **influence parameters** like **velocity**, **person's height** and **reach goal**
- **Extension** of **phase functioned neural network** principle to arbitrary **non-cyclical motions**
- Implementation based on **several Deep Neural Networks (DNNs)** being trained **independently** for **distinct frames**

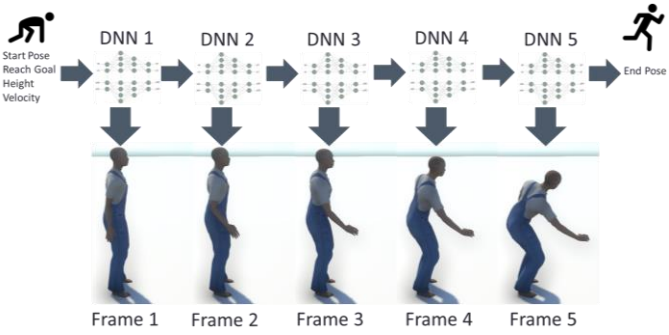

Figure 3: Illustration of the basic concept of the proposed approach. Several DNNs are used to compute the avatar pose for the respective frames 1-5.

Training & Utilization

For **training** the distinct **DNNs**, following steps are performed:

- **Extraction** of **distinct frames** from the desired humanoid motion (e.g. 10 equidistant frames)
- **Assignment** of a **distinct DNN** to **each frame**
- **Supervised training** of the individual networks at **each frame** with **current pose & parameters** as **input** and next **pose & parameters** as **output**

To **generate** natural **motions** from the trained networks the consecutive actions are required:

- **Assignment** of the **current character pose**, **person's height**, desired **velocity** and **reach goal** as **input** values
- **Sequential evaluation** of the chain of **DNNs**
- **Interpolation** between the **resulting poses** using cubic spline interpolation

Results

The novel approach has been used to model **human reach motions** with various influence parameters:

- For **training**, overall a set of **600 000** different **human reach motions** have been artificially generated
- The **pose of the avatar, person's height, reach goal** and **velocity** have been used as **input** parameters
- In total, the networks have been **trained** for **12 hours** using a Nvidia GTX 1080Ti graphics card

Figure 4: Generated reach goals during training.

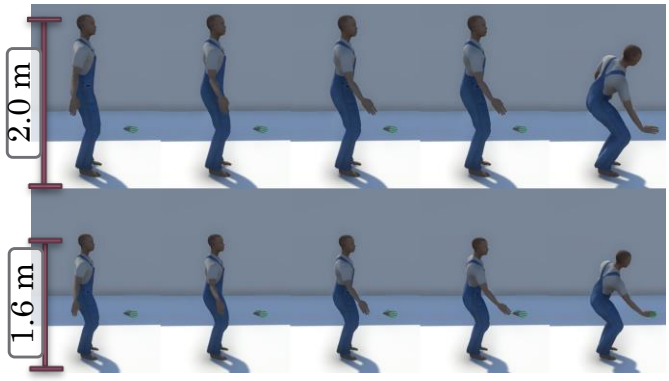

Figure 5: Image series of generated reach motions of the novel DNN approach with varying person's height as input parameter and a constant reach goal.

Outlook

- **Preliminary evaluations** show that novel approach produces **natural motions** while **considering multiple parameters**
- In **future** publications the **applicability** of **real motion capture** data will be **validated**.

[1] Holden D., Komura T., Saito J.: Phase-functioned neural networks for character control.

[2] Hanson et. al: IMMA-intelligently moving manikins in automotive applications.

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