

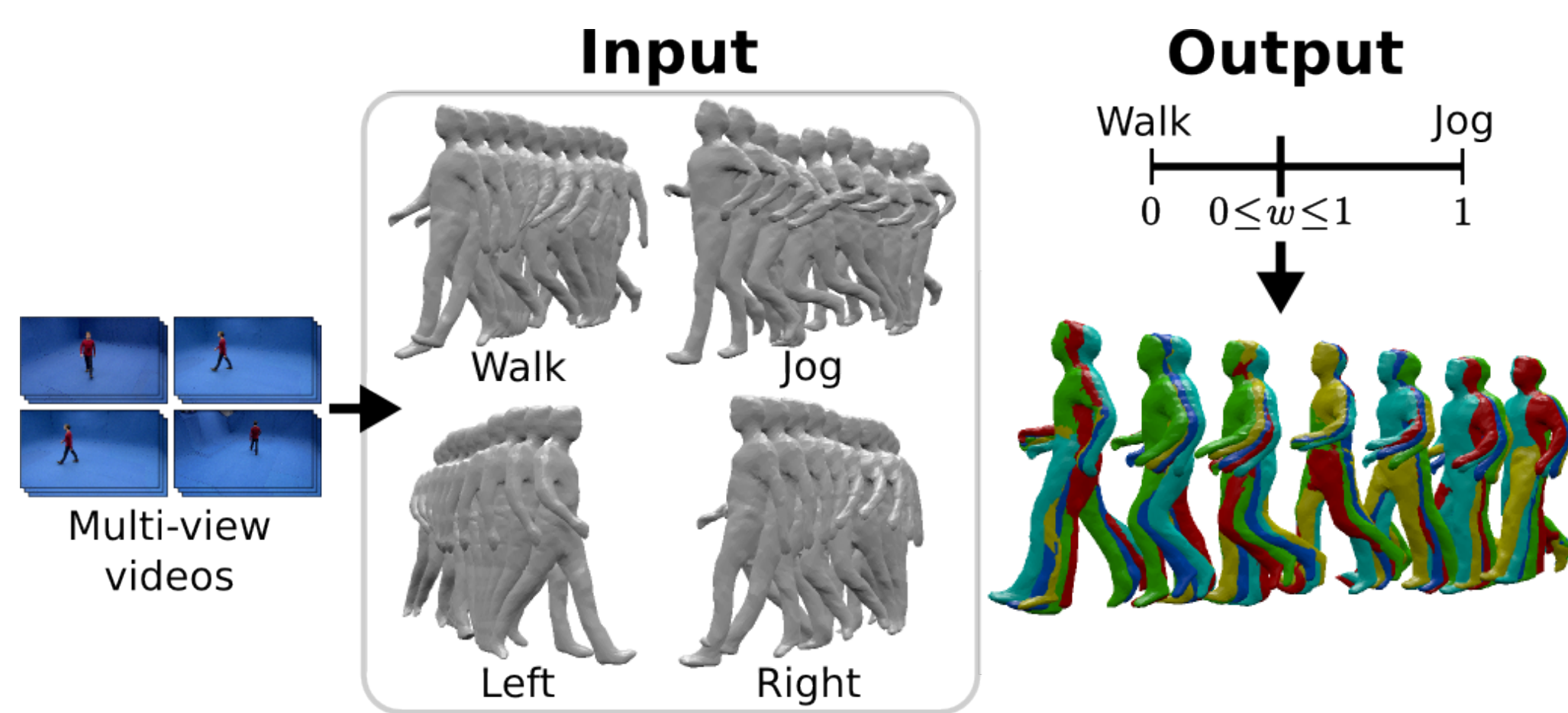
Context

Problem

Variation is an essential component of motion realism, but recent surface capture animation datasets and tools lack such richness.

Objective

Generate variations of captured 4D models automatically for 4D dataset augmentation and realism improvement.



Outputs are statistically similar to the inputs but differ slightly in poses and timing.

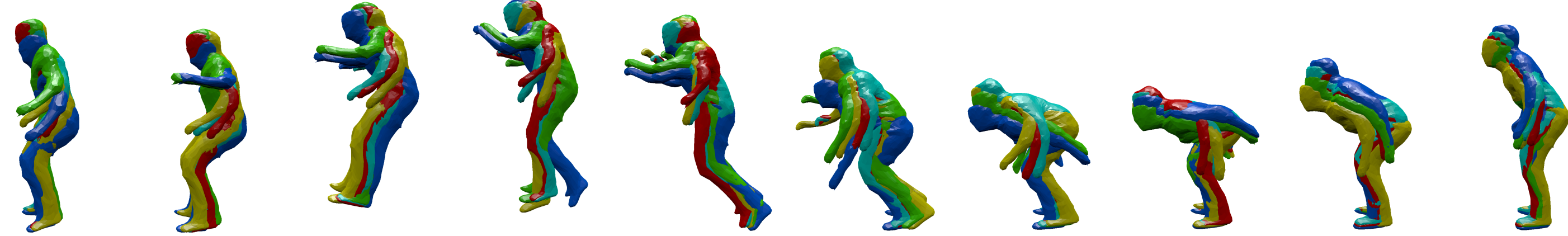
Contributions

- Mesh motion variation generation using Gaussian Process Dynamical Models and a Hybrid Monte Carlo Markov Chain for accurate modelization and synthesis of pose and dynamics.
- Piece-wise linear latent motion sequence interpolation for accurate parametrization of variation generation.

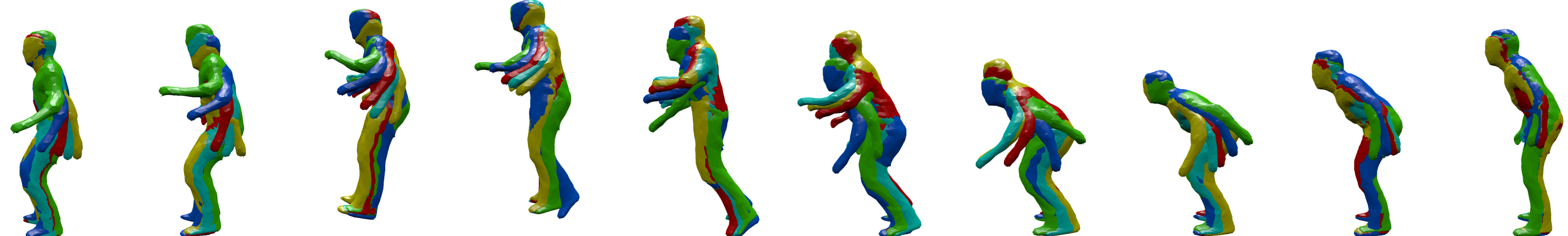
Results

- Overlapped jumping variations (Dataset DAN).

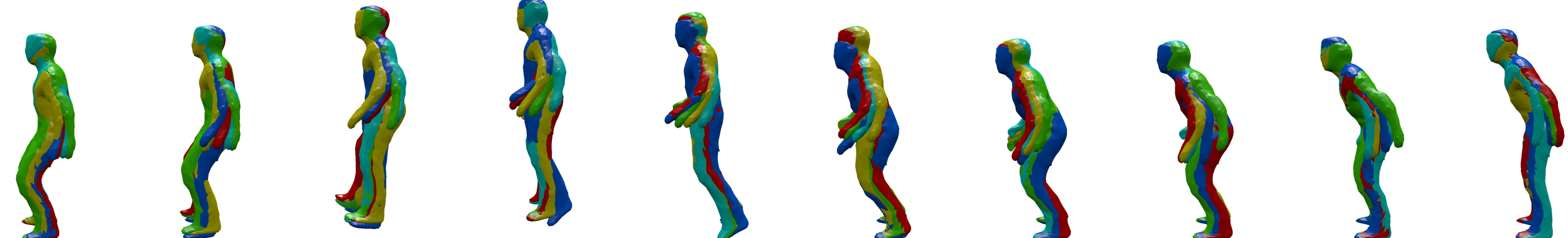
Jumping long



$(1 - w)$ Jumping short + w Jumping long, $w = 0.5$

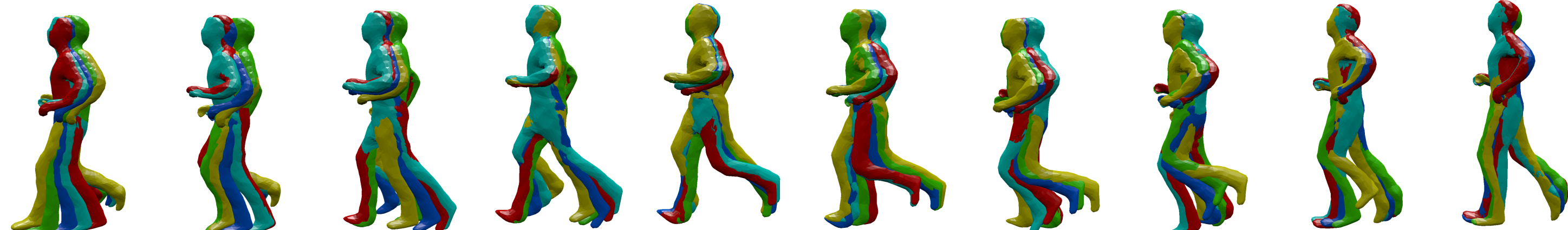


Jumping short

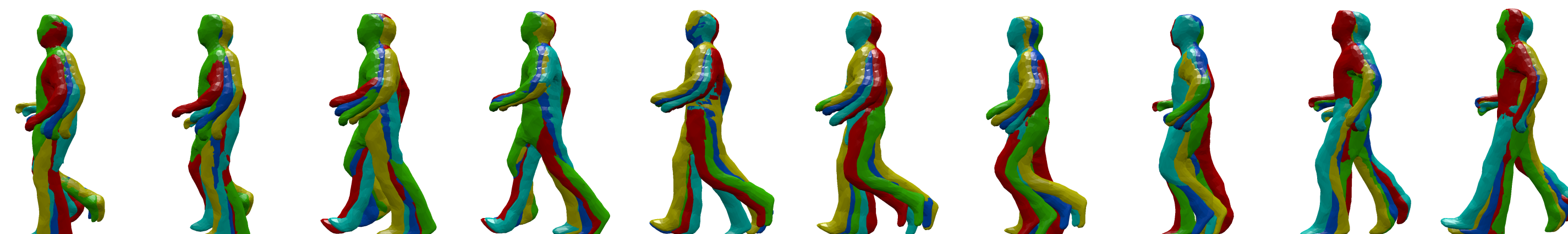


- Overlapped locomotion variations (Dataset DAN).

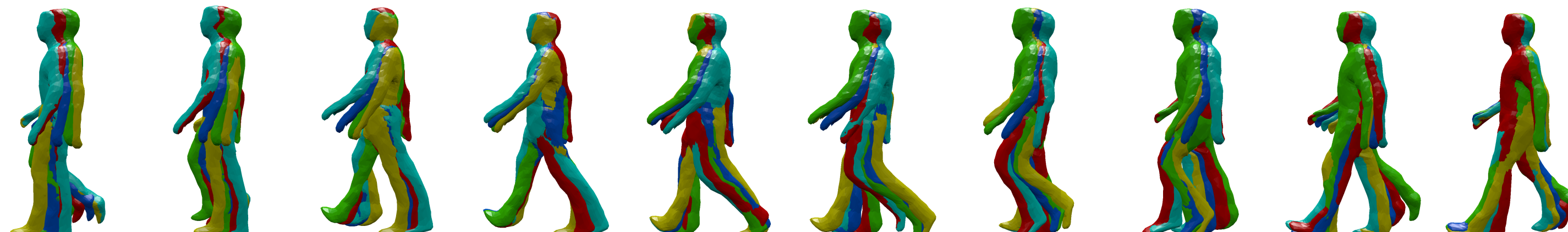
Jogging



$(1 - w)$ Walking + w Jogging, $w = 0.5$



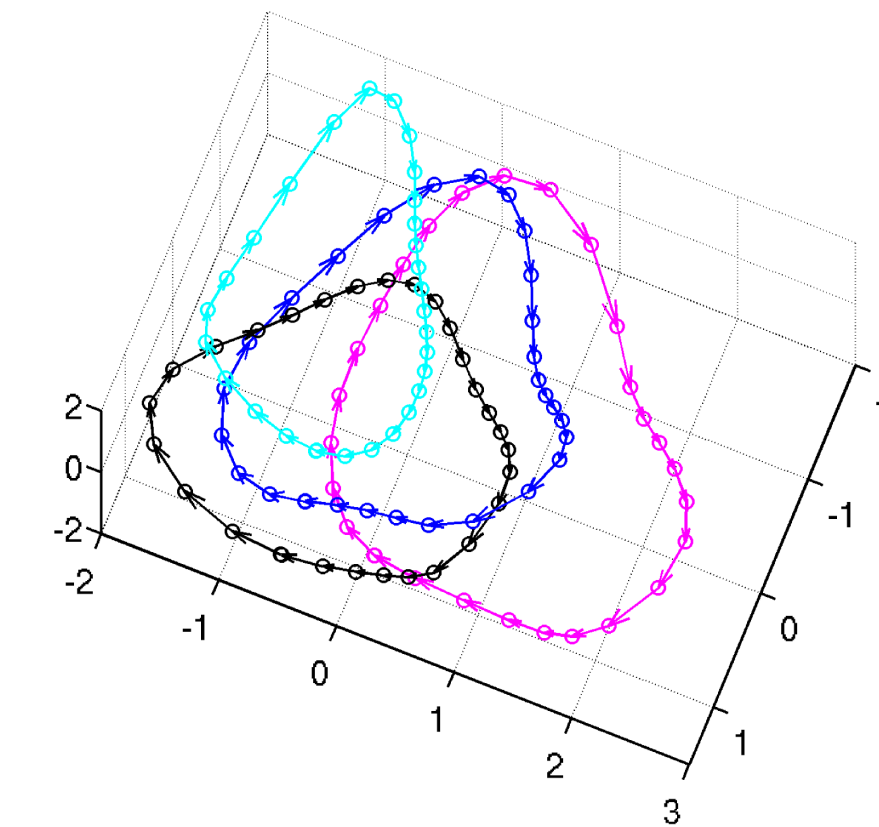
Walking



Method

Shape motion embedding

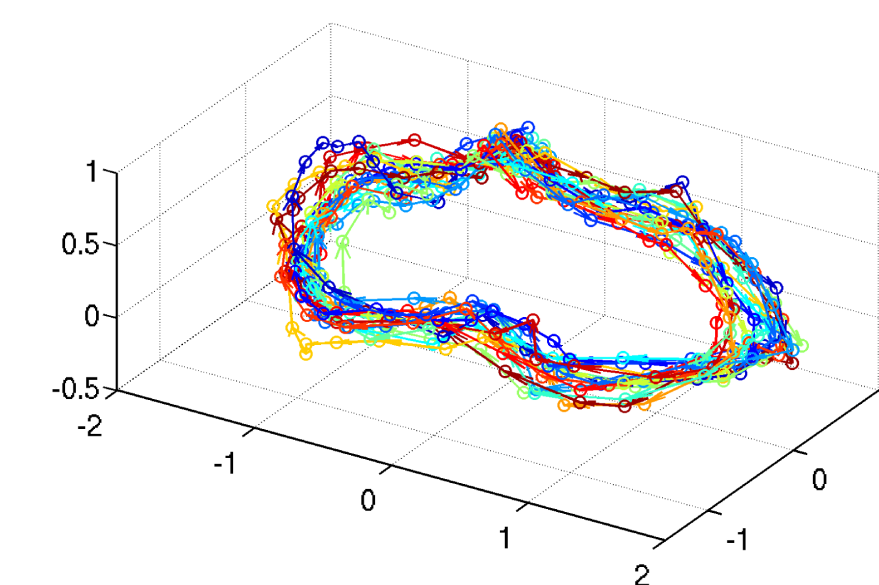
Learn a latent space of poses regularized with dynamics using Gaussian Process Dynamical Models for each body part, given a few sequences of compatible movements.



Latent trajectories of the right leg, learned with sequences *Walk* (blue), *Jog* (black), *Left* (cyan) and *Right* (magenta).

Shape motion sampling

Synthesise variants of a latent motion sequence by sampling with a Markov Chain Monte Carlo method initialized with a mean prediction sequence.



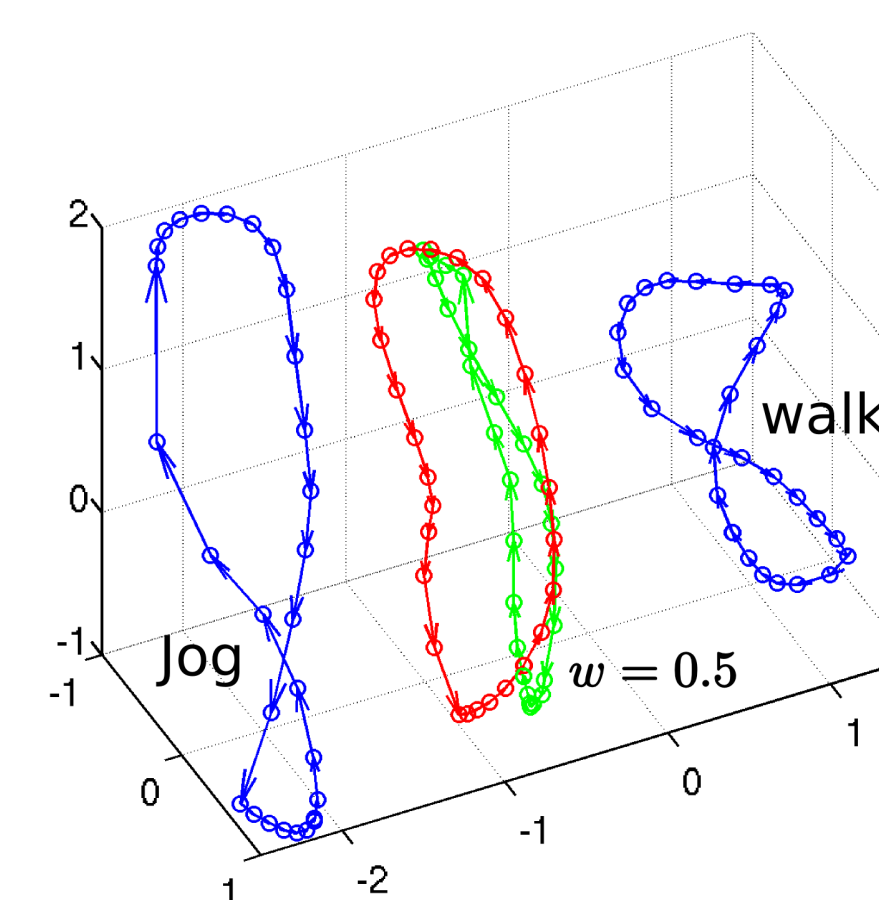
Latent variations of sequence *Walk* for the torso.

Shape motion parametrization

Generate variations for any blended version of an input sequence pair.

- Challenges

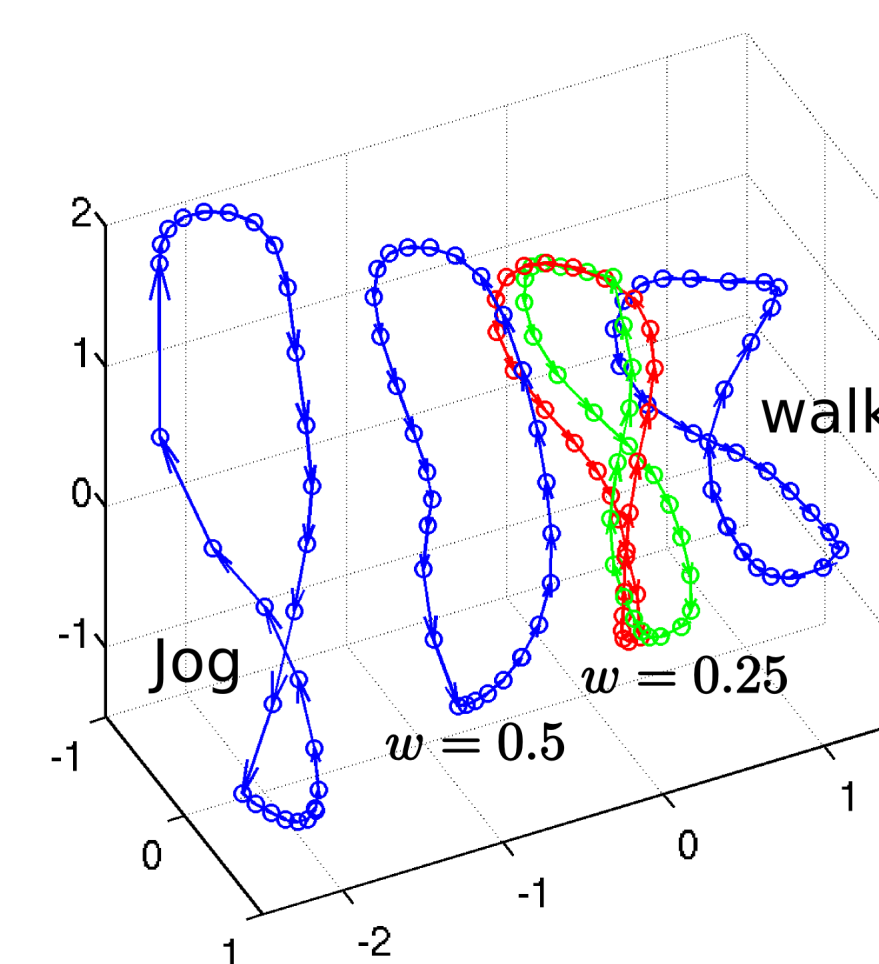
- Degenerate sampling around latent interpolated trajectories.
- Interpolating many mesh motion variations non linearly is costly.
- Blending proportions are not the same in latent and observation space.



GPDM built with sequences: *Walk*, *Jog*, *Left*, *Right*, and a blended version of sequences *Walk* and *Jog* for $w = 0.5$. This latter's latent trajectory (red) does not coincide with the interpolation of *Walk* and *Jog* trajectories (green) in the latent space.

- Algorithm

- Blend mesh sequence pair offline for few weights.
- Build GPDM with theses sequences and generate variations.
- For a new blending weight find closest bounding pre-blending weights.
- Interpolate any two variations of bounding weights' latent trajectories accordingly and reconstruct motion sequence.



Obtaining latent sequence $w = 0.25$ by: (green) interpolating sequences *Walk* and *Jog*, (red) interpolating nearby sequences *Walk* and $w = 0.5$.



Distance between non-linearly interpolated mesh sequence $w = 0.25$ (ground-truth) and: (green) reconstructing interpolation of latent sequences *Walk* and *Jog*, (red) reconstructing interpolation of nearby latent sequences *Walk* and $w = 0.5$.