



# TEMOS: Generating diverse human motions from textual descriptions

Paper, video,  
PyTorch code,  
pretrained models  
available online



<https://mathis.petrovich.fr/temos>

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## Introduction

**Goal:** Given a textual description, the task is to generate **multiple** diverse 3D human motions

**Prior work:** Deterministic (generate only one motion), jittery, complex models and losses

**Solution:** Encode the text into a gaussian distribution, use a non-autoregressive Transformer

**Contributions:**

- Novel cross-modal variational model that can produce **diverse** motions
- Achieves **state-of-the-art** performance
- Provide **extensive ablation study**

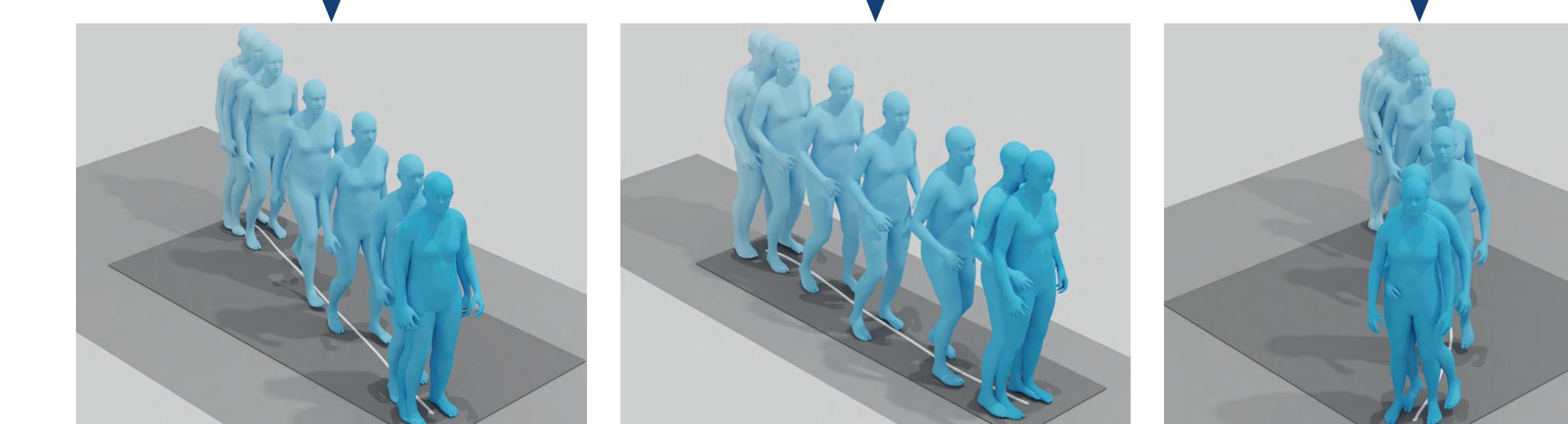
A man walks in a circle clockwise.

$$z \in \mathcal{N}(0, 1)$$



A person stands, then walks a few steps, then stops again.

$$z \in \mathcal{N}(0, 1)$$



## TEMOS: TExt-to-MOtionS

- Supports both **skeletons** and **SMPL body** motions
- Non auto-regressive architecture
- Motion-level motion encoder  $\mathcal{M}_{enc}$
- Sentence-level text encoder  $\mathcal{T}_{enc}$

### Training

- Reconstruction loss on the motion-to-motions branch (left)
- Reconstruction loss on the text-to-motions branch (right)
- Cross-modal losses to encourage a joint space between motion and text
- Gaussian priors to regularize the joint latent space

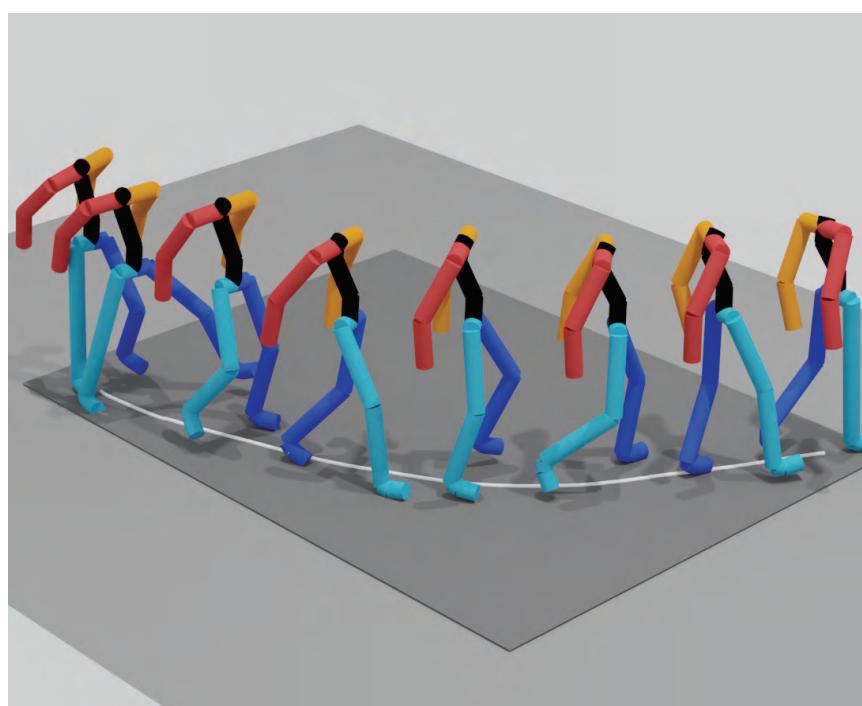
### Inference

- Only the text-to-motions branch (right)
- Ability to sample multiple motions given a single textual description

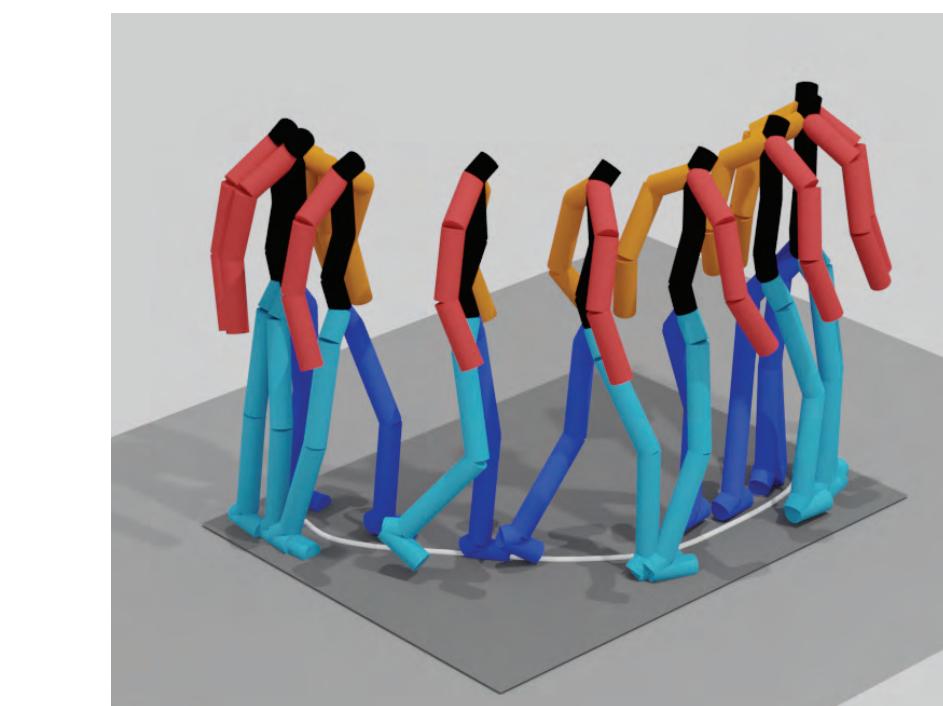
## KIT Motion-Language Dataset

- 3911 motions sequences with 6353 sequence level sentence annotations
- Processed with MMM framework, as in prior work

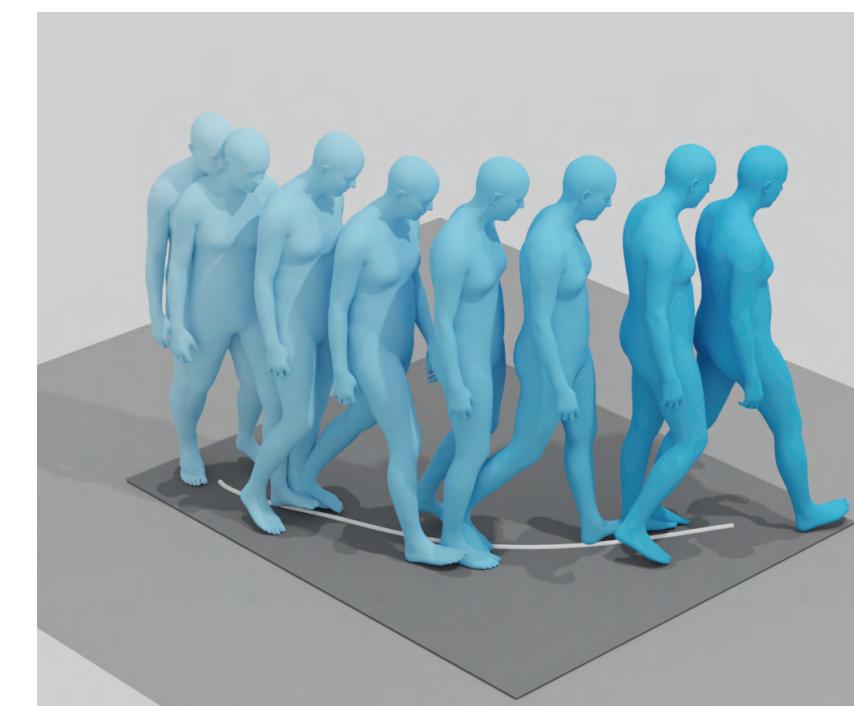
### MMM joint coordinates



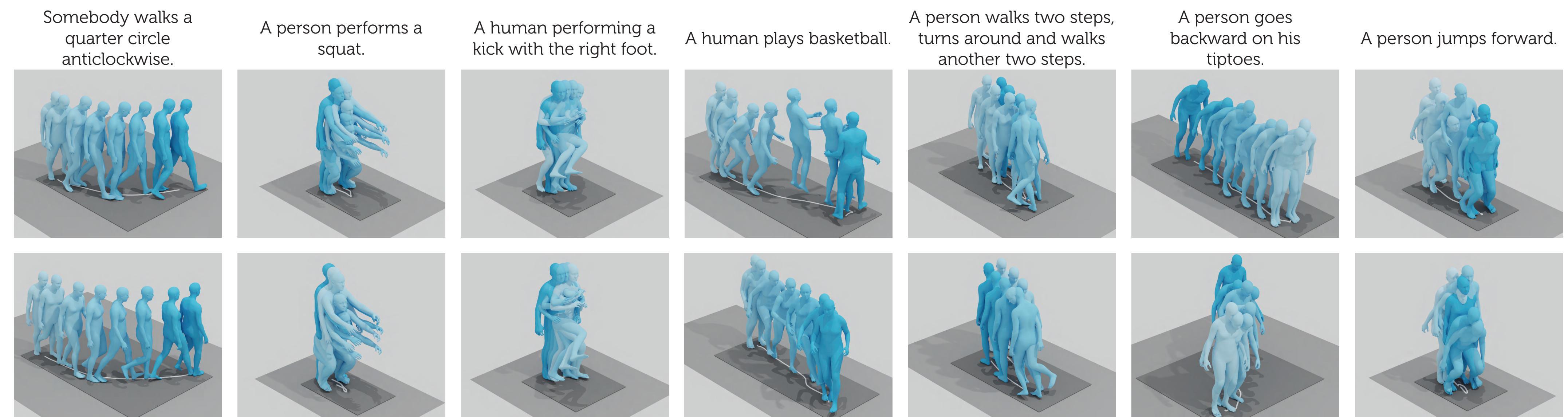
### SMPL joint coordinates



### SMPL pose parameters



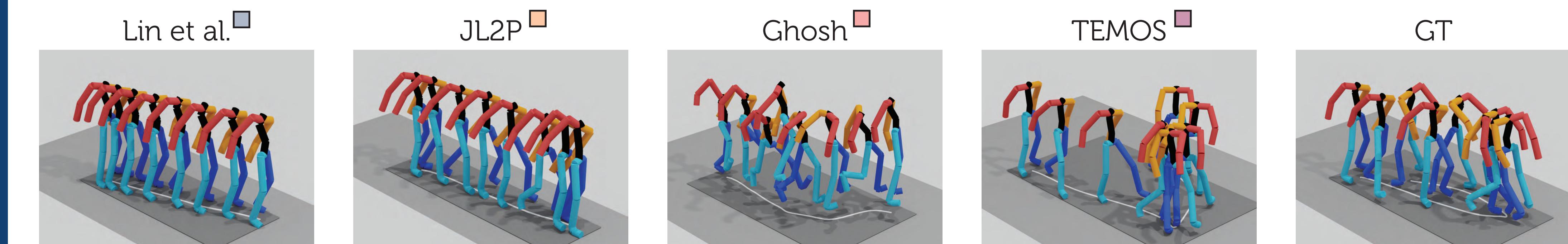
## Qualitative results



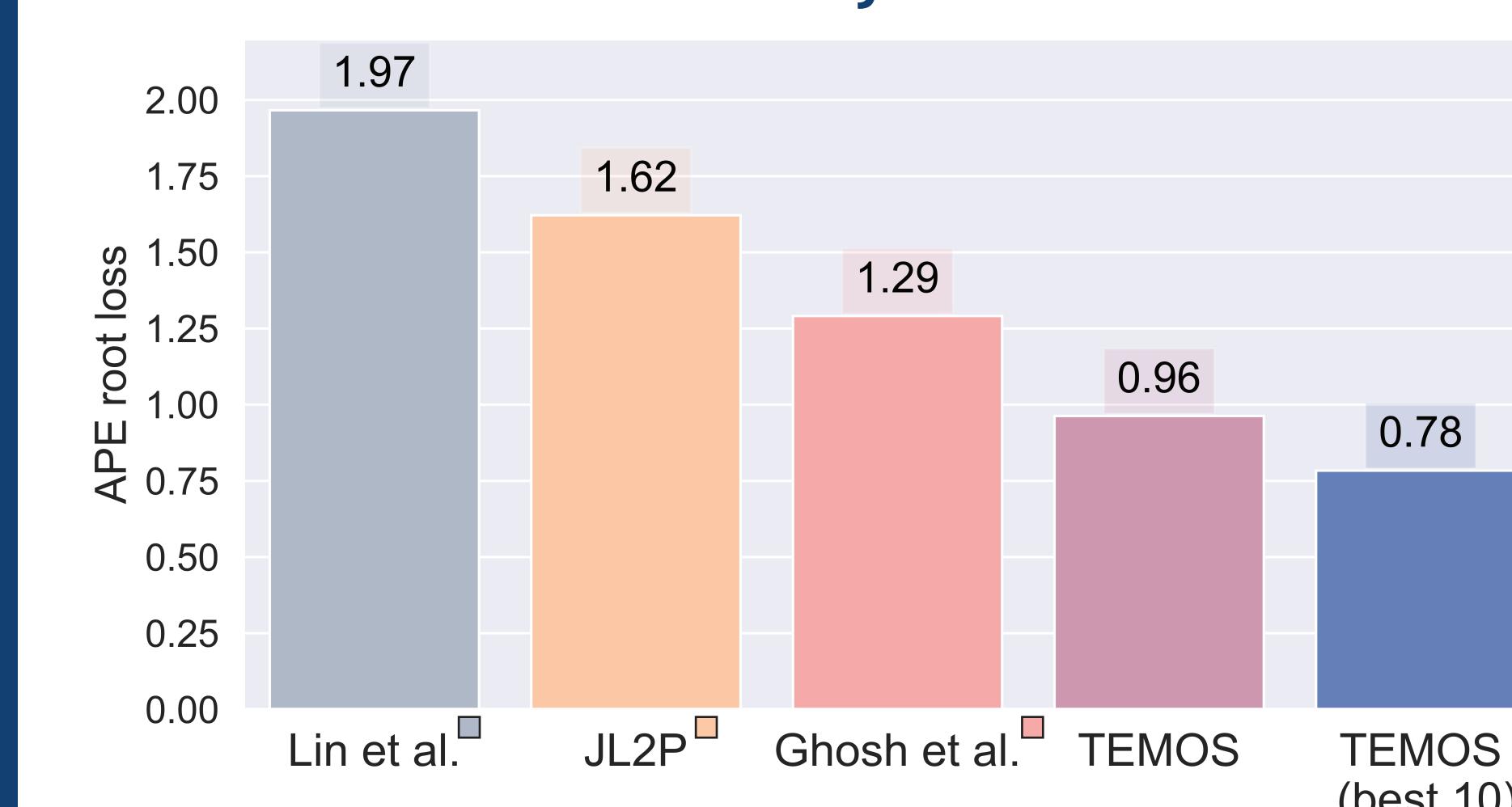
## Ablation study: architecture and losses

Arch.	$\mathcal{L}_{KL}$	$\mathcal{L}_E$	Average Positional Error ↓			Average Variance Error ↓		
			root	glob.	mean	root	glob.	mean
GRU	$KL(\phi^T, \phi^M) + KL(\phi^M, \phi^T) + KL(\phi^T, \psi) + KL(\phi^M, \psi)$	✓	1.443	1.433	0.105	1.451	0.600	0.599
Transf.	$KL(\phi^T, \psi)$ w/out $\mathcal{M}_{enc}$	✗	1.178	1.168	0.106	1.189	0.506	0.505
Transf.	$KL(\phi^T, \phi^M) + KL(\phi^M, \phi^T) + KL(\phi^T, \psi) + KL(\phi^M, \psi)$	✗	1.091	1.083	0.107	1.104	0.449	0.448
Transf.	$KL(\phi^T, \psi) + KL(\phi^M, \psi)$ w/out cross-modal KL losses	✗	1.080	1.071	0.107	1.095	0.453	0.452
Transf.	$KL(\phi^T, \psi) + KL(\phi^M, \psi)$ w/out cross-modal KL losses	✓	0.993	0.983	0.105	1.006	0.461	0.460
Transf.	$KL(\phi^T, \phi^M) + KL(\phi^M, \phi^T)$ w/out Gaussian priors	✓	1.049	1.039	0.108	1.065	0.472	0.471
Transf.	$KL(\phi^T, \phi^M) + KL(\phi^M, \phi^T) + KL(\phi^T, \psi) + KL(\phi^M, \psi)$	✓	0.963	0.955	0.104	0.976	0.445	0.445
			0.445	0.445	0.005	0.448		

## Comparison with previous work



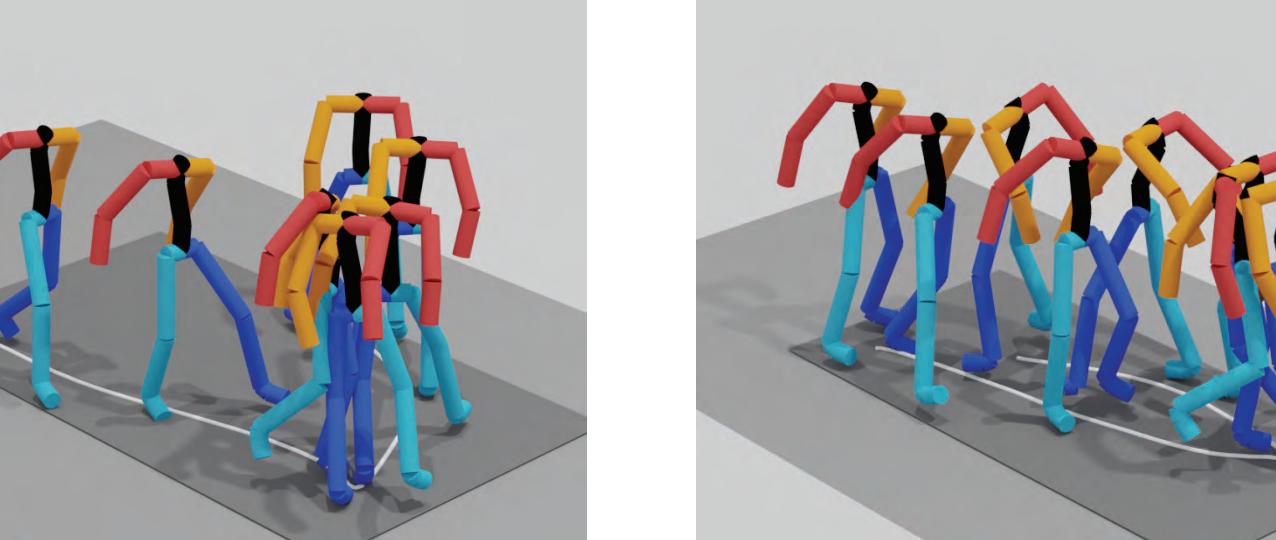
APE root joint error



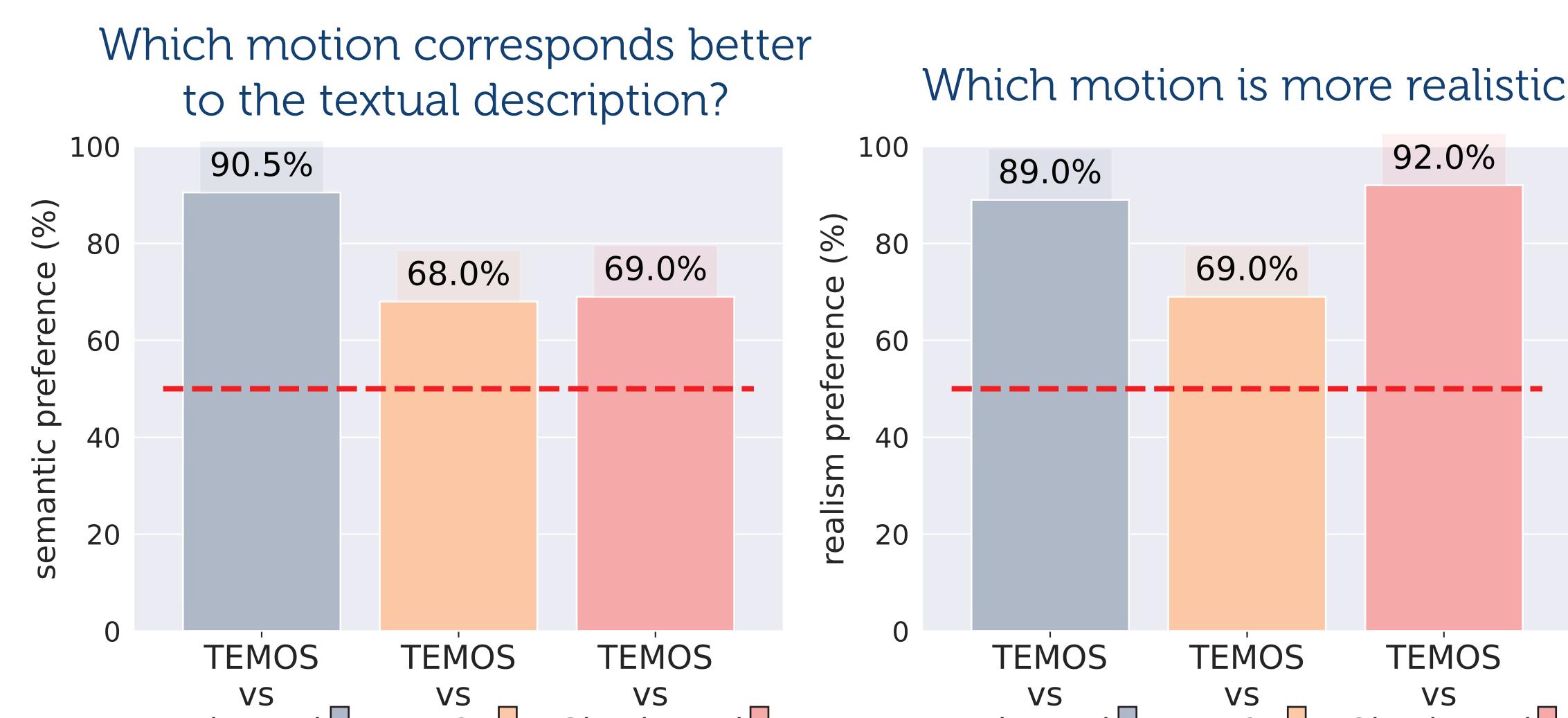
A person walks two steps, turns around and walks another two steps.

TEMOS

GT



### Human studies



## References

- Lin et al. Generating animated videos of human activities from natural language descriptions (NeurIPS Workshop 2018)
- Ahuja et al. Language2Pose: Natural language grounded pose forecasting (3DV 2019)
- Ghosh et al. Synthesis of compositional animations from textual descriptions (ICCV 2021)