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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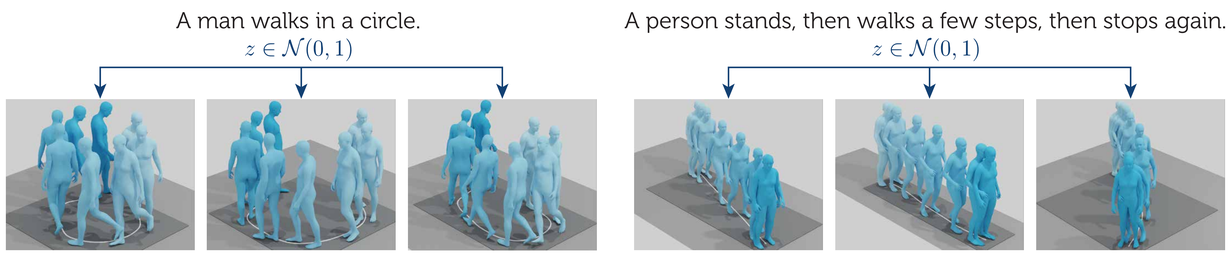
Introduction

- Given a textual description, the task is to generate **multiple** diverse 3D human motions
- Achieves **state-of-the-art performance** with a non-autoregressive Transformer model with a sequence-level embedding
- Supports both **skeletons** and **SMPL body** motions



TEMOS: TExt-to-MOtionS

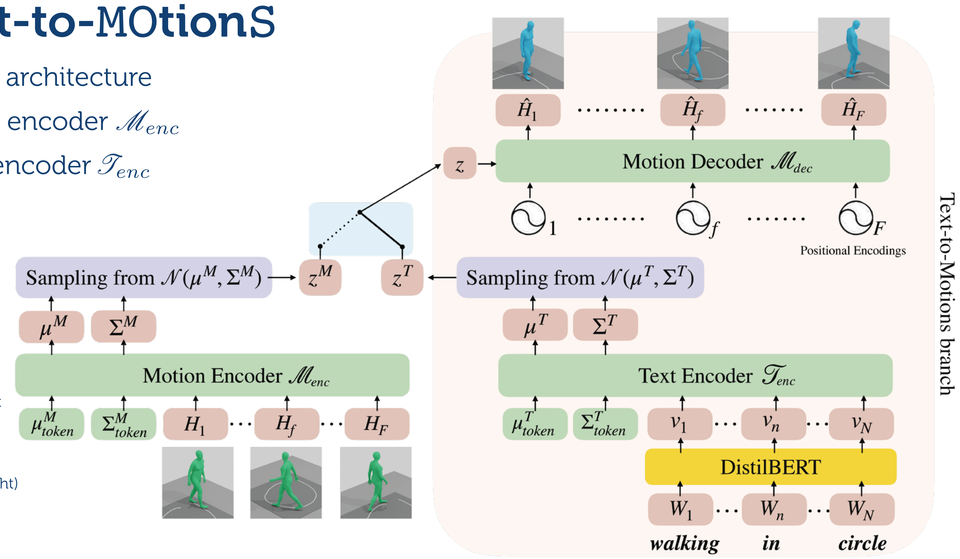
- Non auto-regressive architecture
- *Motion-level* motion encoder $\mathscr{M}_{enc}$
- *Sentence-level* text encoder $\mathscr{T}_{enc}$

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

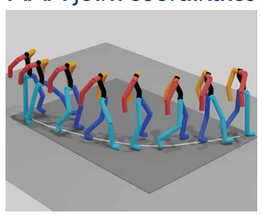
- Only the **text-to-motions branch** (right)
- Ability to sample **multiple motions** given a **single textual description**



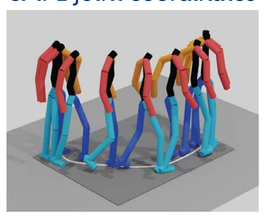
KIT Motion-Language Dataset

- 3911 motions sequences with 6353 sequence level sentence annotations
- Processed with MMM framework, as in prior work
- Processed with SMPL (correspondance with AMASS)

MMM joint coordinates

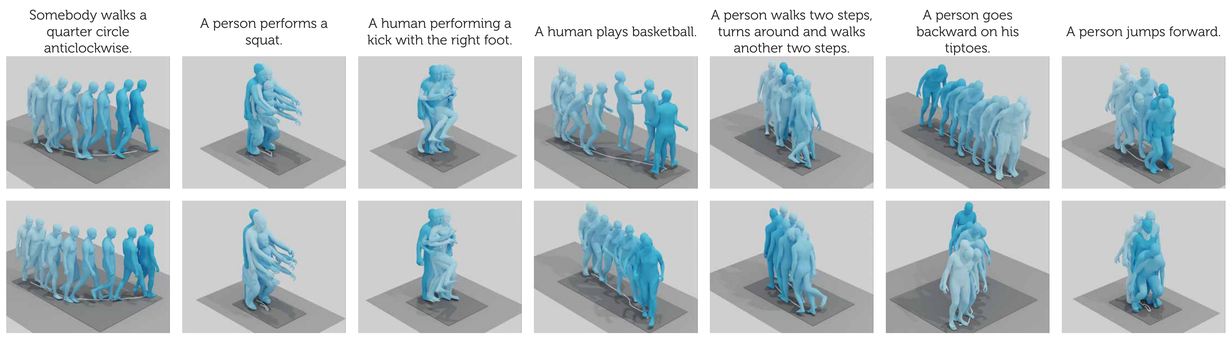


SMPL joint coordinates



SMPL pose parameters

Qualitative results

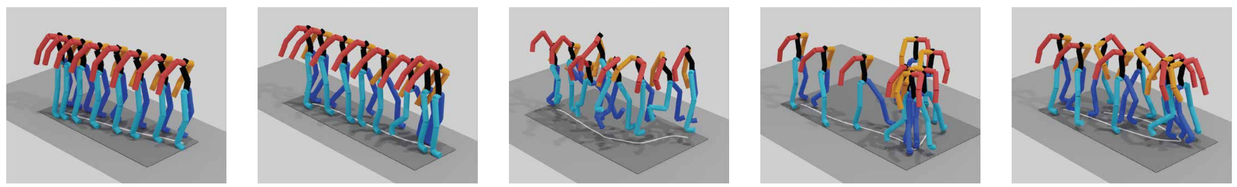


Ablation study: architecture and losses

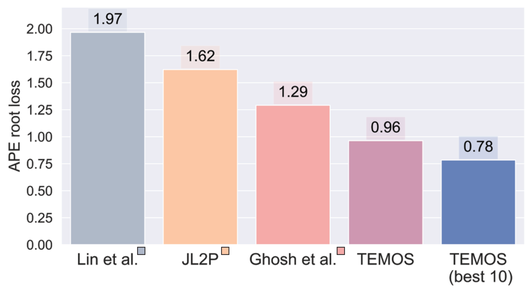
Arch.	$\mathcal{L}_{KL}$	$\mathcal{L}_E$	Average Positional Error ↓ root joint	glob. traj.	mean loc.	mean glob.	Average Variance Error ↓ root joint	glob. traj.	mean loc.	mean glob.
GRU	$KL(\phi^T,\phi^M)+KL(\phi^M,\phi^T)+KL(\phi^T,\psi)+KL(\phi^M,\psi)$	✓	1.443	1.433	0.105	1.451	0.600	0.599	0.007	0.601
Transf.	$KL(\phi^T,\psi)$ **w/out** $\mathscr{M}_{enc}$	✗	1.178	1.168	0.106	1.189	0.506	0.505	0.006	0.508
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	0.005	0.451
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	0.005	0.456
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	0.005	0.463
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	0.005	0.475
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**	0.005	**0.448**

Comparison with previous works

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

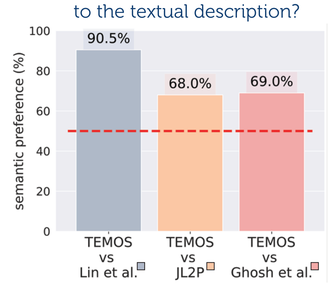


APE root joint error

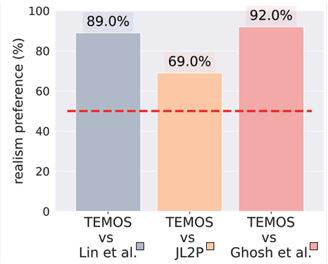


Human studies

Which motion corresponds better to the textual description?



Which motion is more realistic?



References

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