北京航空航天大學
BEIHANG UNIVERSITY

虚拟现实技术与系统国家重点实验室
CHINA'S STATE KEY LABORATORY OF VIRTUAL REALITY TECHNOLOGY AND SYSTEMS

鹏城实验室 PCL Peng Cheng Laboratory

Stony Brook University

Human Motion Synthesis and Control via Contextual Manifold Embedding

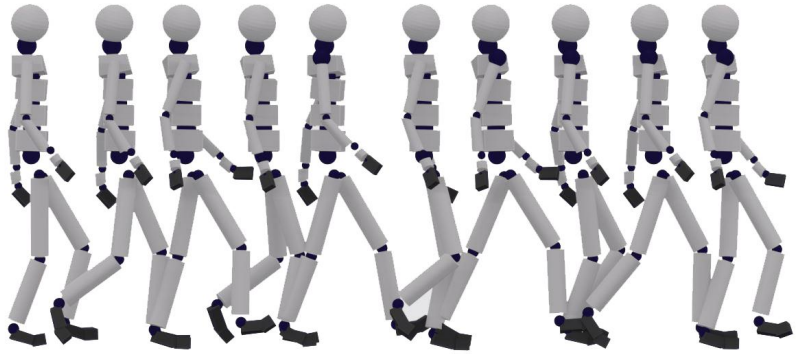
Rui Zeng[1,2], Ju Dai[2], Junxuan Bai[1,2], Junjun Pan[1,2] and Hong Qin [3]

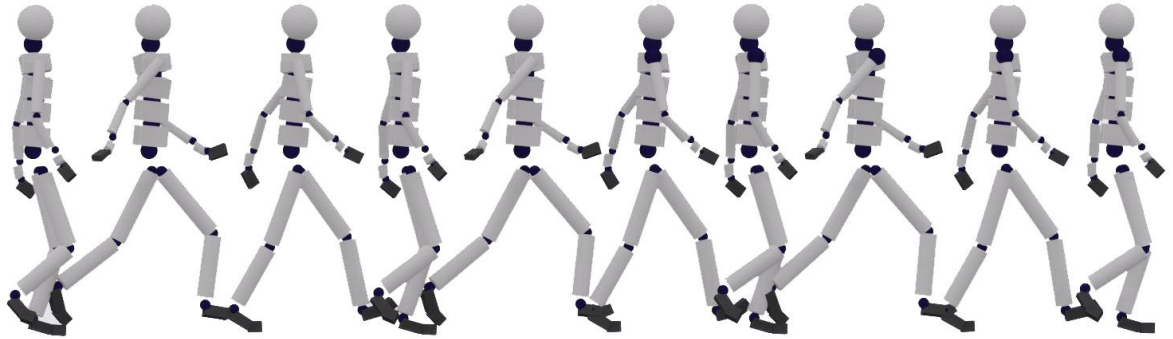
[1] State Key Laboratory of Virtual Reality Technology and Systems, Beihang University, Beijing, China

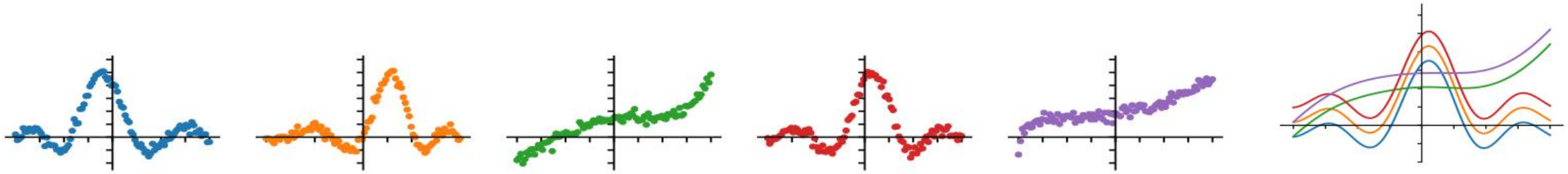
[2] Peng Cheng Laboratory, Shenzhen, China

[3] Department of Computer Science, Stony Brook University (SUNY), Stony Brook, NY, USA

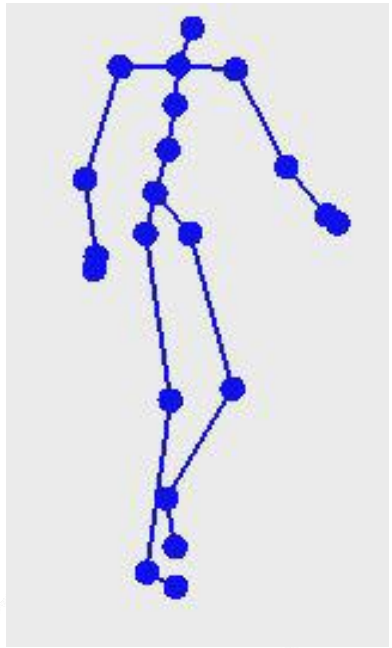
Motivation

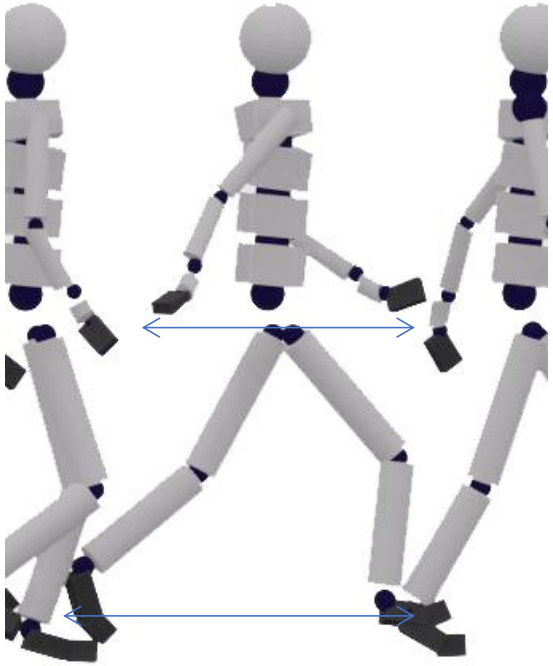


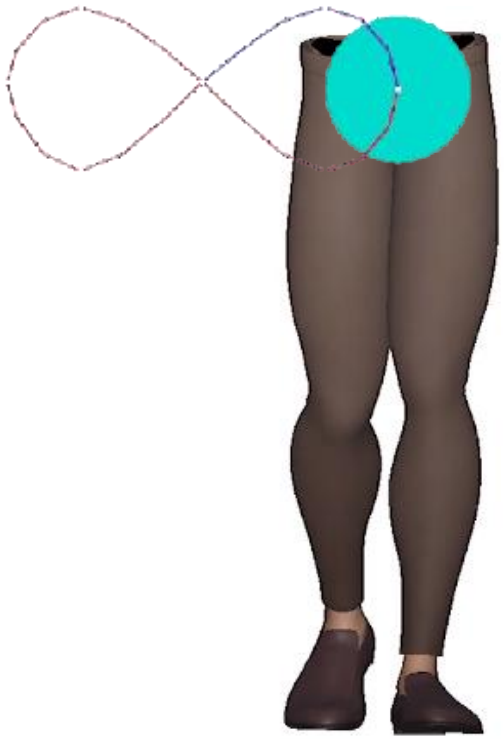




Motivation



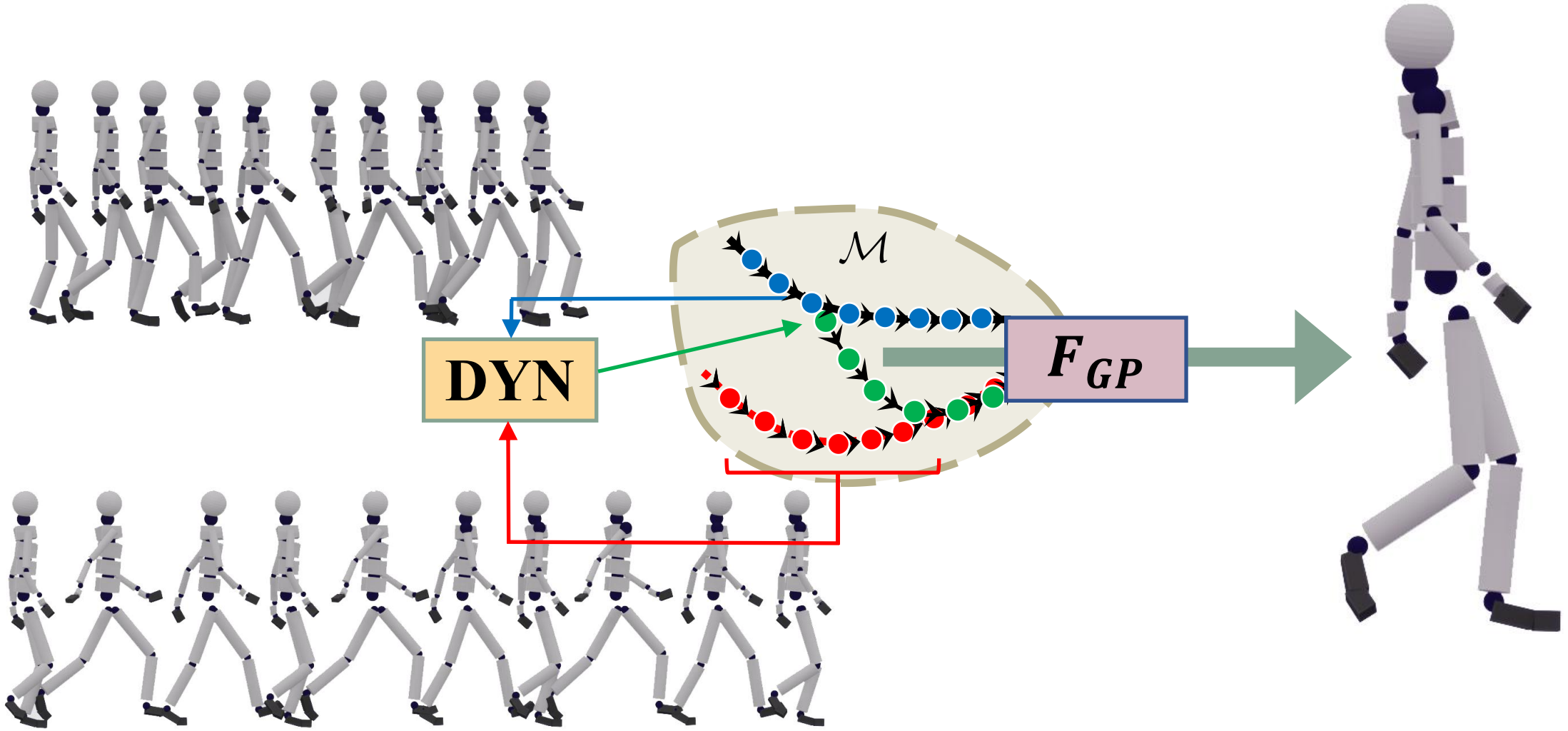




Motivation

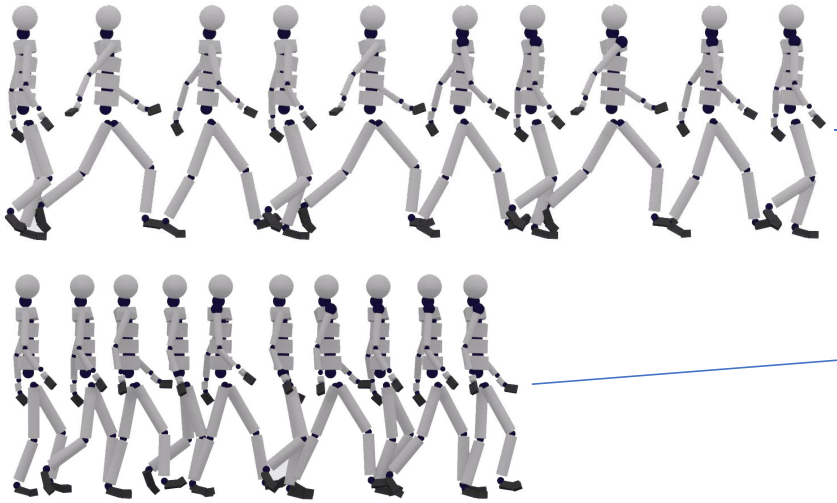
- 整合与区分不同状态的运动，分辨是随机运动还是改变状态
- 通过提供目标状态实现状态的维持与过渡，并合成自然序列

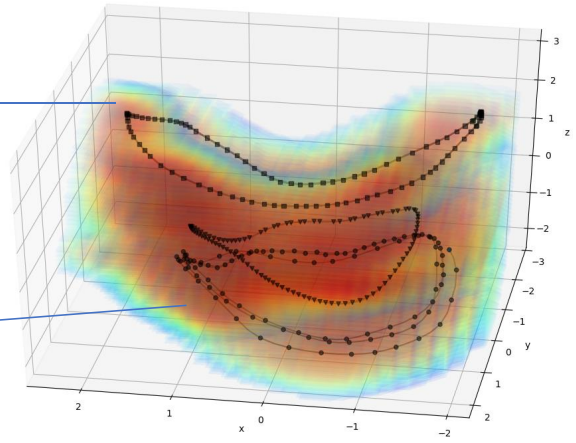
Model Overview



Embedding

$$\mu(X) = F_{GP}(X, \mathbf{Y}) = \mathbf{K}_X \mathbf{K}^{-1} \mathbf{Y},$$
$$\Sigma(X) = k(X, X) - \mathbf{K}_X^T \mathbf{K}^{-1} \mathbf{K}_X,$$

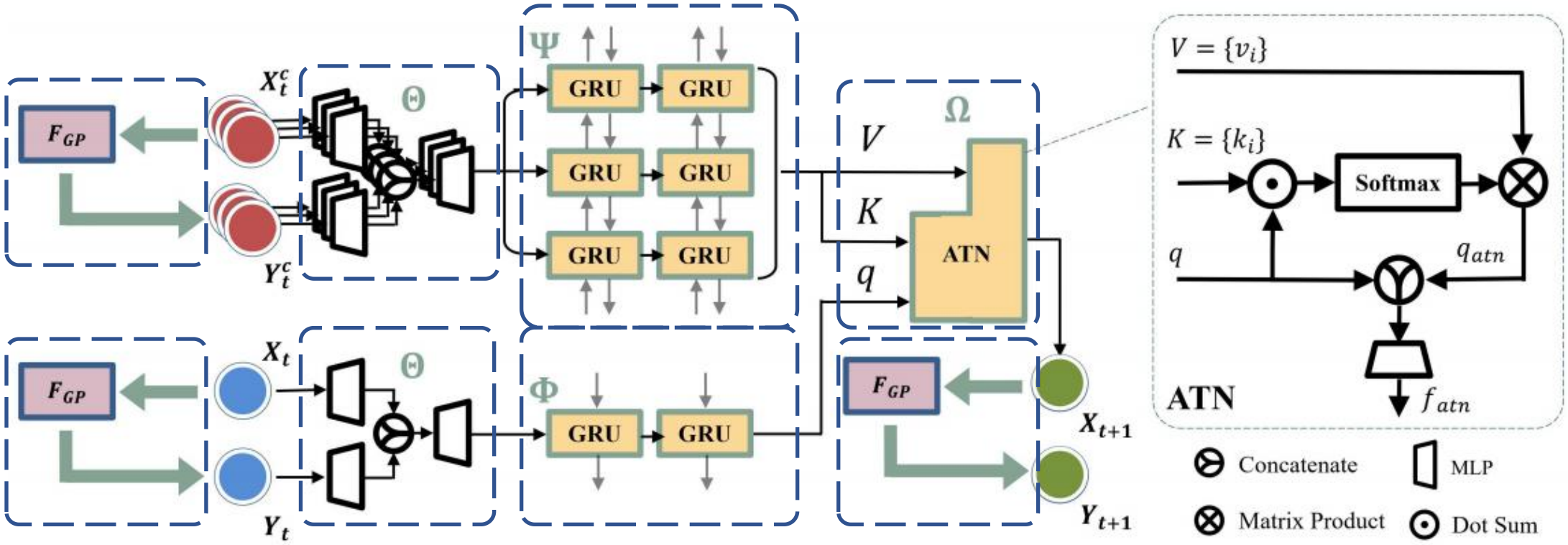




$N \times D$

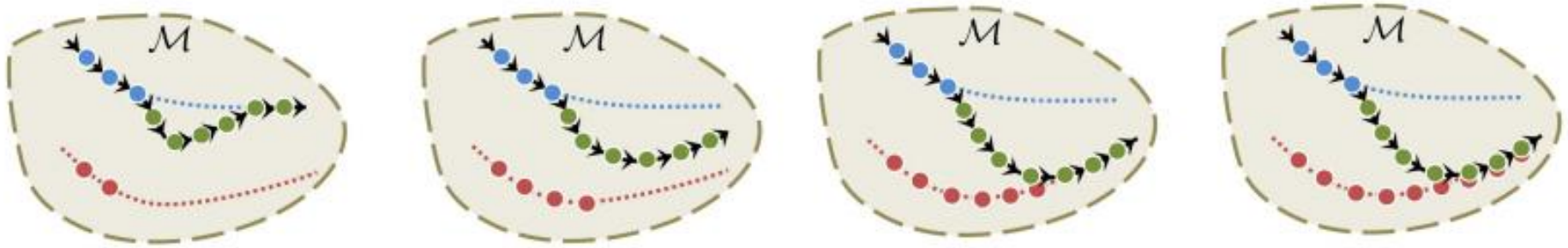
$N \times d$

DYN


F_{GP}
X_t^c
Y_t^c
Θ
Ψ
GRU
GRU
GRU
GRU
GRU
GRU
V
K
q
Ω
ATN
F_{GP}
X_{t+1}
Y_{t+1}
F_{GP}
X_t
Y_t
Θ
Φ
GRU
GRU
$V = \{v_i\}$
$K = \{k_i\}$
Softmax
q
q_{atn}
ATN
f_{atn}
Concatenate
MLP
Matrix Product
Dot Sum

Loss

$$L = \sum_{i=1}^{T} \left(\left\| X_{i+1} - DYN(X_i, X_i^h) \right\|^2 + \lambda \left\| Y_{i+1} - F_{GP}\left[DYN(X_i, X_i^h) \right] \right\|^2 \right),$$



$n < lower\ bound$ lower < n < upper bound $n = upper\ bound$ $n > upper\ bound$

Figure A. Transition senarios in different length of control states.

Loss

$$L = \sum_{i=1}^{T} \left(\left\| X_{i+1} - DYN(X_i, X_i^h) \right\|^2 + \lambda \left\| Y_{i+1} - F_{GP}\left[DYN(X_i, X_i^h) \right] \right\|^2 \right),$$

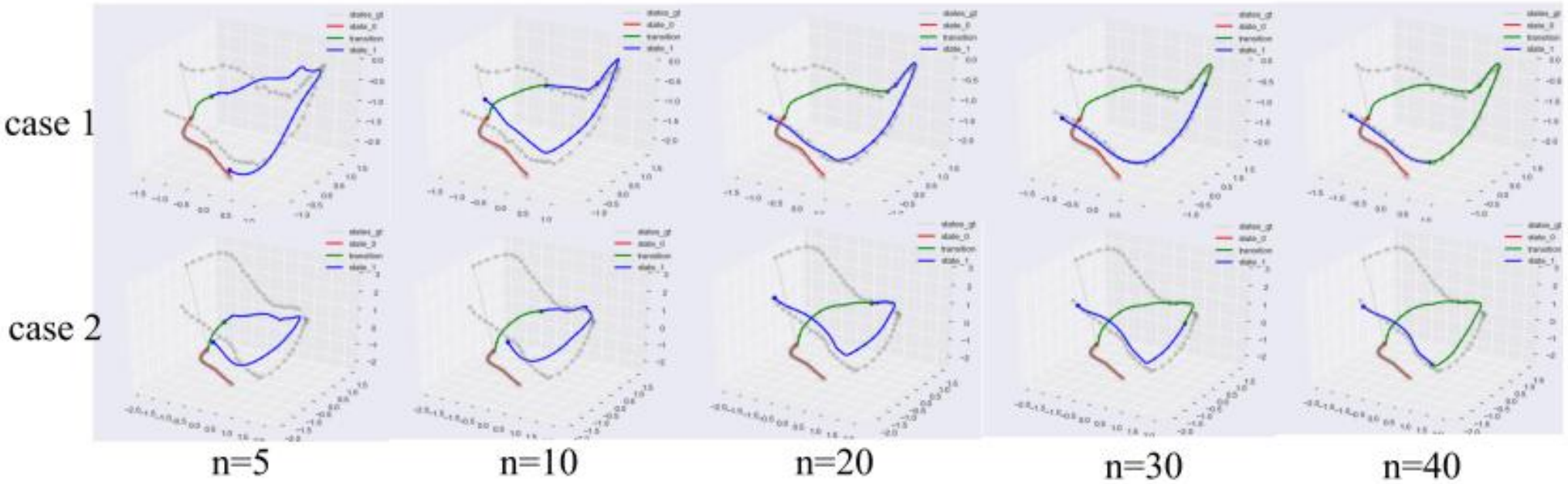
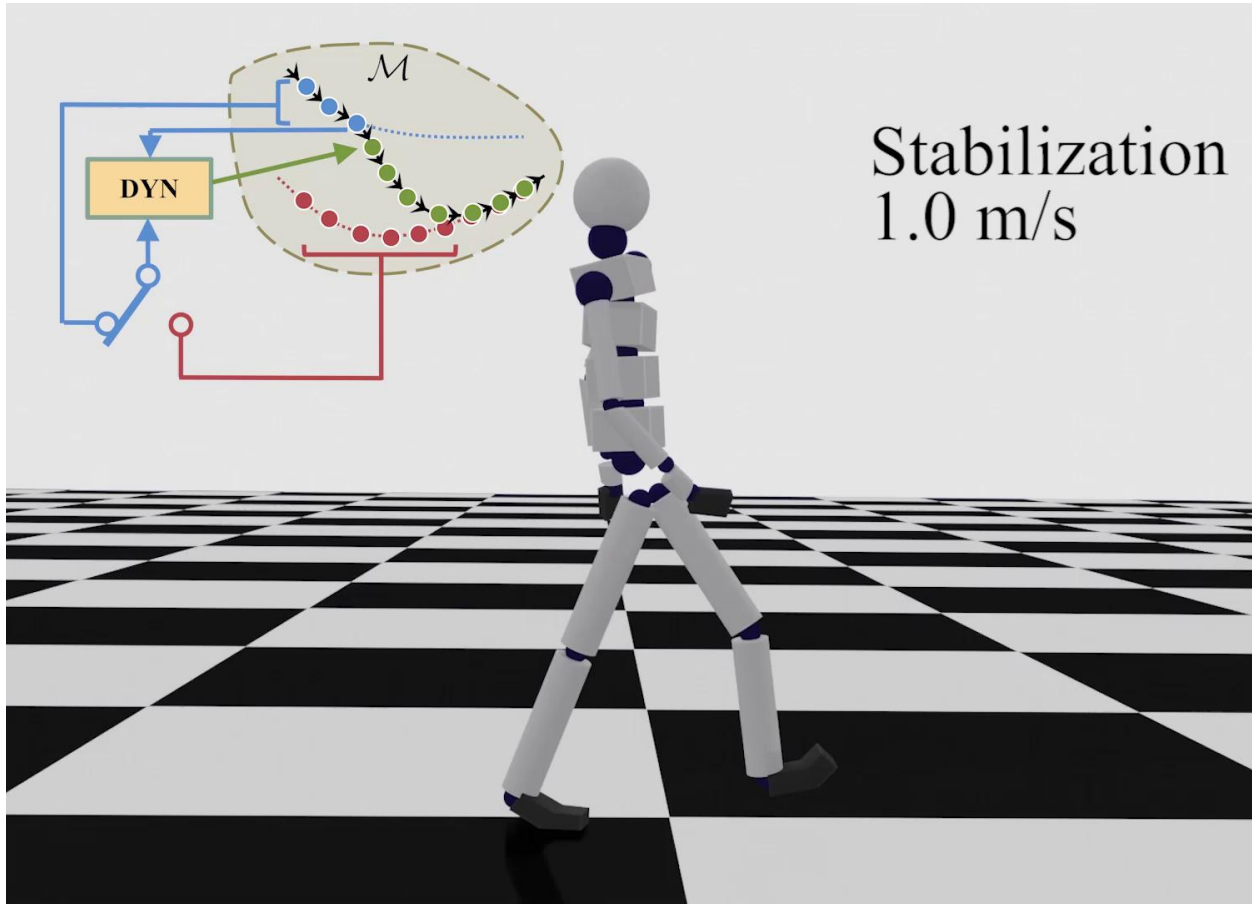
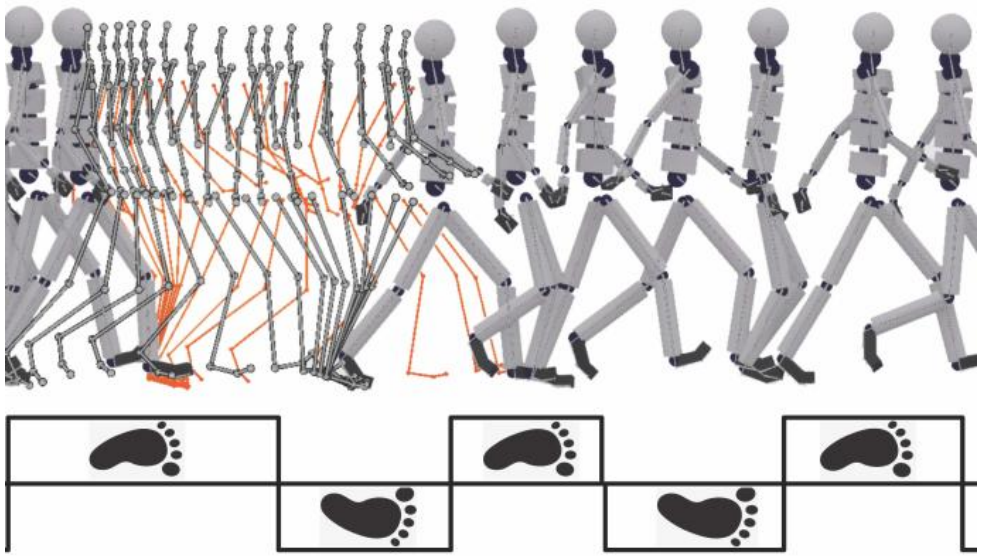


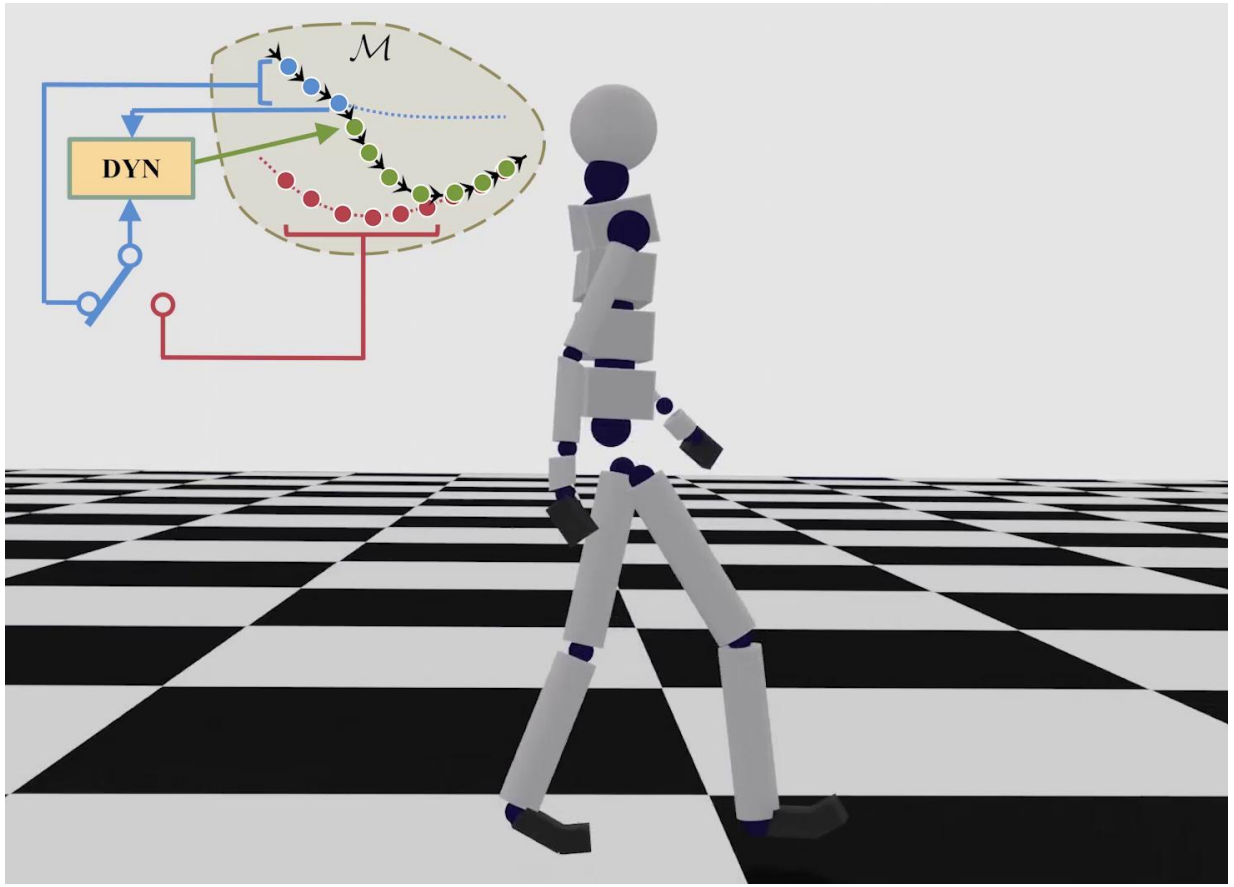
Figure B. Latent transition results for different control length.

Qualitative Evaluation



Qualitative Evaluation





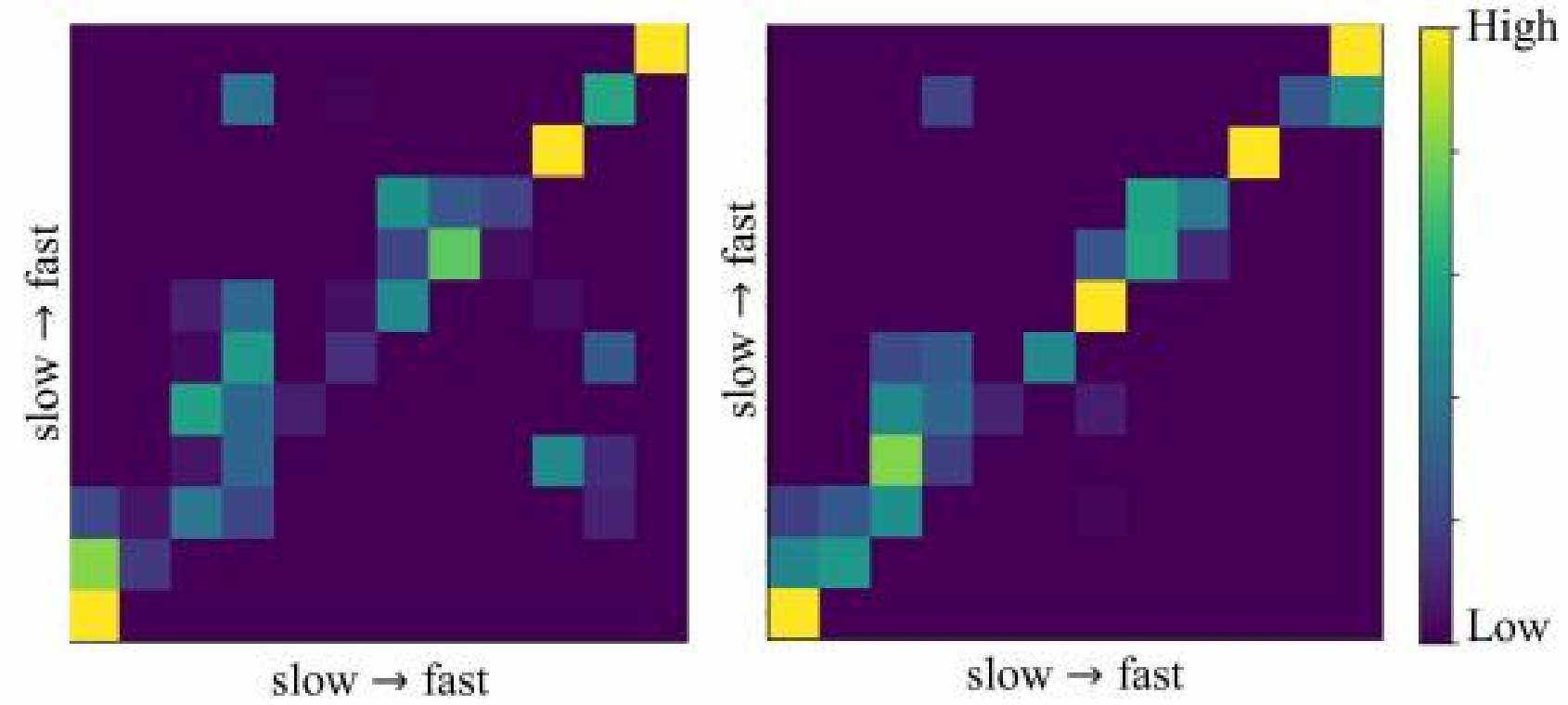
Quantitative Evaluation

- MMD

$$MMD(X,Y) = ||\frac{1}{n}\sum_{i=1}^{n}\phi(x_i) - \frac{1}{m}\sum_{j=1}^{m}\phi(y_j)||_H^2$$

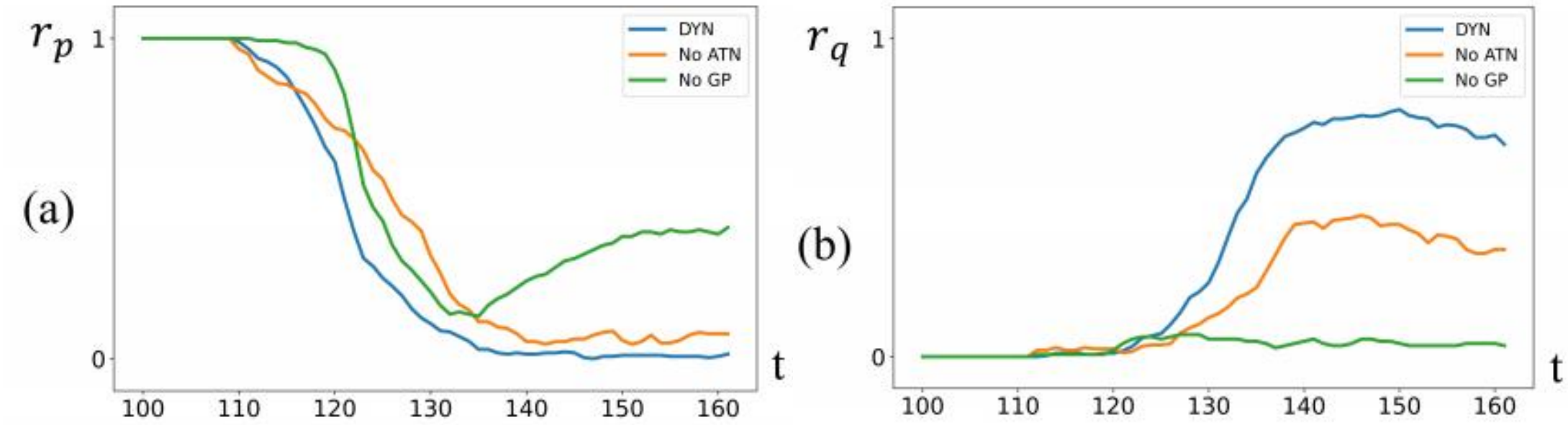
Quantitative Evaluation

- Stablization



Quantitative Evaluation

- Transition



Thank you