[Rebuttal] DiffuseBot: Breeding Soft Robots With Physics-Augmented Generative Diffusion Models
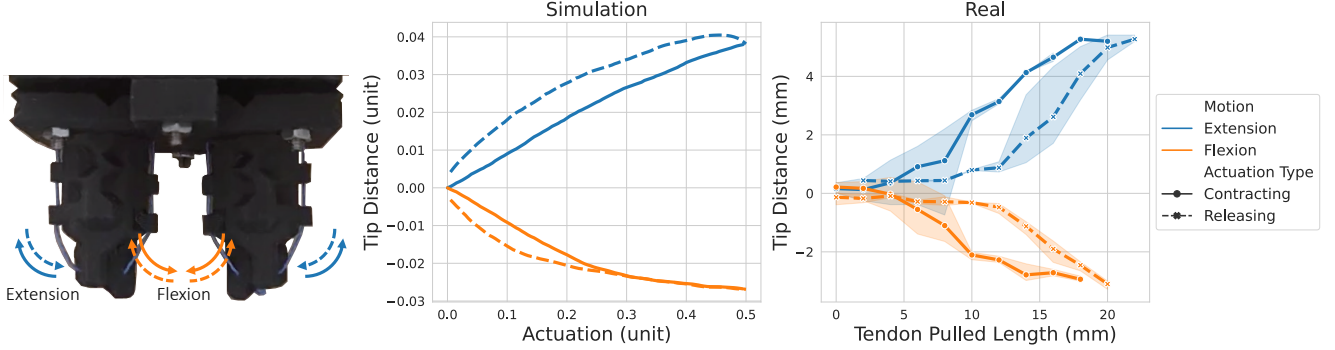

Figure. A1: Quantitative analysis of behavior between simulation and physical robots.

Table. A1: Comparison with additional soft robot co-design baseline. We report mean (the first number), standard deviation (superscript), and max (the number after the slash), following the setting of Table 2 (baseline comparison) in the main paper. We adapt DiffAqua to using a more general set of primitives that include bunny, car, cat, cow, avocado, dog, horse, and sofa.

Methods	Passive Dynamics		Locomotion		Manipulation	
	Balancing	Landing	Crawling	Hurdling	Gripping	Moving a Box
DiffAqua [2]	$0.014^{.023}/0.102$	$0.293^{.459}/0.993$	$0.027^{.015}/0.049$	$0.022^{.011}/0.034$	$0.010^{.001}/0.012$	$0.007^{.008}/0.031$
DiffuseBot	$\mathbf{0.706}^{.078}/\mathbf{0.919}$	$\mathbf{0.965}^{.026}/\mathbf{0.998}$	$\mathbf{0.092}^{.016}/\mathbf{0.115}$	$\mathbf{0.031}^{.011}/\mathbf{0.178}$	$\mathbf{0.026}^{.002}/\mathbf{0.031}$	$\mathbf{0.047}^{.019}/\mathbf{0.091}$

Table. A2: Other statistics including mean and standard deviation (supscript) for Table 2 in the main paper.

Methods	Passive Dynamics		Locomotion		Manipulation	
	Balancing	Landing	Crawling	Hurdling	Gripping	Moving a Box
Particle-based	$0.040^{.000}$	$0.863^{.005}$	$0.019^{.001}$	$0.006^{.001}$	$-0.010^{.001}$	$0.043^{.027}$
Voxel-based	$0.040^{.000}$	$0.853^{.002}$	$0.024^{.000}$	$0.027^{.000}$	$-0.009^{.000}$	$0.025^{.022}$
Implicit Function	$0.106^{.147}$	$0.893^{.033}$	$0.043^{.024}$	$\mathbf{0.044}^{.063}$	$0.006^{.012}$	$0.033^{.030}$
Diff-CPPN	$0.091^{.088}$	$0.577^{.425}$	$0.055^{.023}$	$0.019^{.029}$	$0.007^{.008}$	$0.022^{.017}$
DiffuseBot	$\mathbf{0.706}^{.078}$	$\mathbf{0.965}^{.026}$	$\mathbf{0.092}^{.016}$	$0.031^{.011}$	$\mathbf{0.026}^{.002}$	$\mathbf{0.047}^{.019}$

Table. A3: Comparison with other types of generative models other than diffusion-based ones. We report mean and standard deviation (superscript), following the setting of Table 1 in the main paper.

Methods	Passive Dynamics		Locomotion		Manipulation	
	Balancing	Landing	Crawling	Hurdling	Gripping	Moving a Box
Cano-VAE [1]	$0.058^{.062}$	$0.901^{.044}$	$0.011^{.009}$	$0.014^{.011}$	$0.009^{.002}$	$0.025^{.015}$
DiffuseBot	$\mathbf{0.653}^{.107}$	$\mathbf{0.964}^{.029}$	$\mathbf{0.081}^{.018}$	$\mathbf{0.035}^{.030}$	$\mathbf{0.027}^{.004}$	$\mathbf{0.044}^{.021}$

References

[1] An-Chieh Cheng, Xueting Li, Sifei Liu, Min Sun, and Ming-Hsuan Yang. Autoregressive 3d shape generation via canonical mapping. In *European Conference on Computer Vision*, pages 89–104. Springer, 2022.

[2] Pingchuan Ma, Tao Du, John Z Zhang, Kui Wu, Andrew Spielberg, Robert K Katzschmann, and Wojciech Matusik. Diffaqua: A differentiable computational design pipeline for soft underwater swimmers with shape interpolation. *ACM Transactions on Graphics (TOG)*, 40(4):1–14, 2021.