

Diffusion Generative Flow Samplers: Improving Learning Signals Through Partial Trajectory Optimization

Dinghuai Zhang*, Ricky T. Q. Chen, Cheng-Hao Liu, Aaron Courville &
Yoshua Bengio

Thomas Mousseau

October 17, 2025

Overview

1. Problem Setup

- 1.1 Legged Locomotion Challenges
- 1.2 GFlowNet's Role in Addressing Terrain Benchmarking Challenges

2. Methodology and Architecture

- 2.1 Conditional GAN for Terrain Generation
- 2.2 GFlowNet and Active Learning

3. Evaluations and Results

- 3.1 Diversity and Quality of Generated Terrains
- 3.2 Sample Efficiency and Benchmarking Performance

4. Conclusion

- 4.1 Key Insights
- 4.2 Future Directions and Usage since its release

Legged Locomotion Challenges

Emerging Topic in Legged Robotics

Terrain-aware locomotion has become an emerging topic in legged robotics. However, it is hard to generate diverse, challenging, and realistic unstructured terrains in simulation, which limits the way researchers evaluate their locomotion policies.

GFlowNet's Role in Addressing Terrain Benchmarking Challenges

Key Challenges for Terrain Benchmarking

To achieve reliable quantification of robustness, terrain samples should resemble real terrains in the wild. The generation process should be controllable to produce high-quality terrains that are challenging to a user-specified extent. Finally, the sampler must maintain terrain quality and diversity simultaneously.

- GFlowNet ensures high-quality terrains and diversity among those included in the final benchmark by providing probabilistic sampling from unnormalized distributions.
- It addresses realism through flow-based modeling of complex terrains.
- Controllability via reward-guided active learning for user-specified challenges.
- Quality-diversity balance through efficient exploration of terrain spaces.

Conclusion
