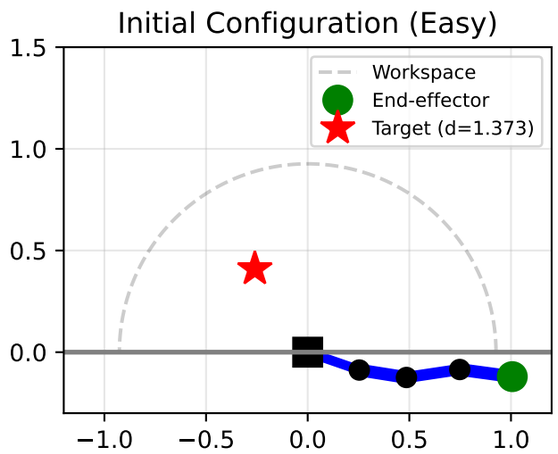
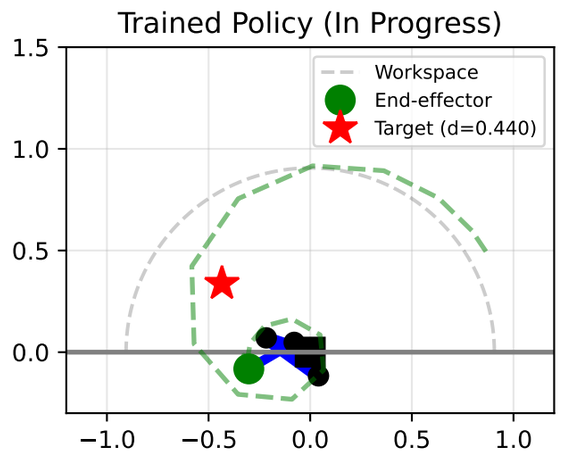
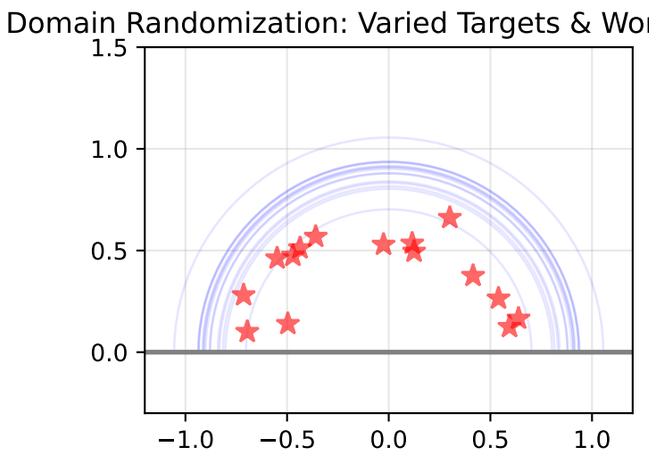
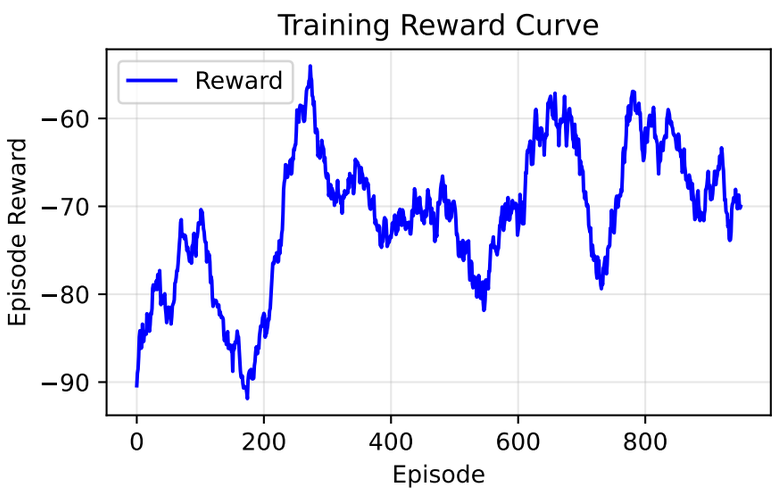
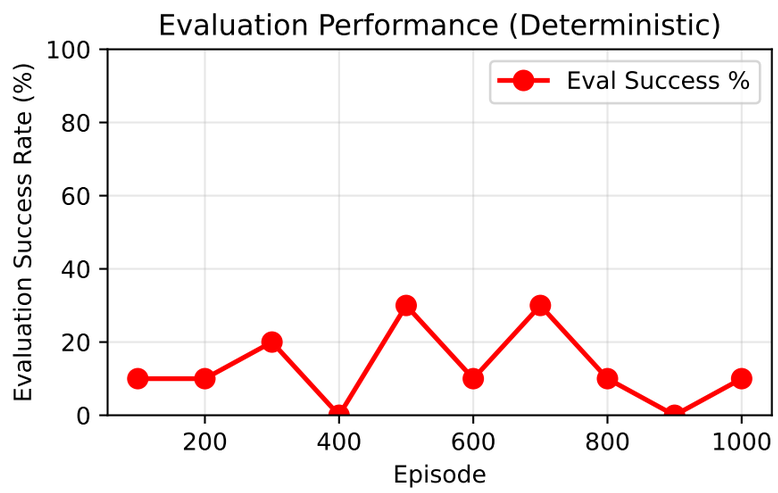
FlexBot V2: Robot Arm Control with Sim2Real Best Practices
PPO + Domain Randomization + Curriculum Learning

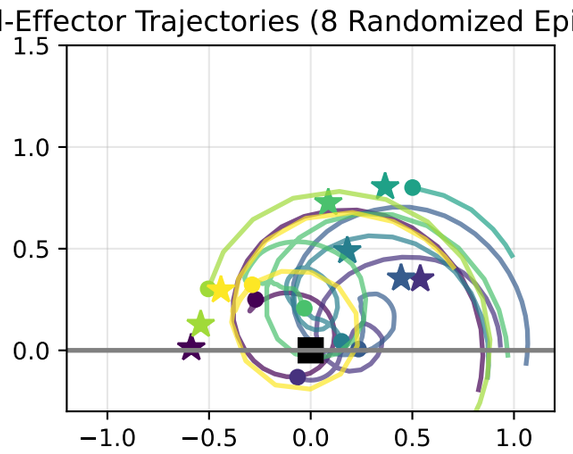










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DOMAIN RANDOMIZATION PARAMETERS
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Physical Properties:
• Segment lengths: ±30% variation
• Segment masses: 0.5x - 1.5x
• Friction coefficient: ±20%
• Torque limits: ±20%

Noise Injection:
• Action noise: σ = 0.02
• Observation noise: σ = 0.01

Goal Variation:
• Random target positions
• Within reachable workspace
• Upper hemisphere only

Curriculum Learning:
• Difficulty 0→1 over 70% of training
• Increasing randomization range
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SIM2REAL TRANSFER PIPELINE
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┌─────────────────┐
│ Domain Random.  │
│ (Synthetic Data)│
└─────────────────┘
        ↓
┌─────────────────┐
│   PPO Training  │
│ • Actor-Critic  │
│ • GAE Advantages│
│ • Curriculum    │
└─────────────────┘
        ↓
┌─────────────────┐
│ Robust Policy   │
│ (Generalizes to │
│  unseen dynamics)│
└─────────────────┘
        ↓
┌─────────────────┐
│ Real Robot      │
│ (Zero/Few-shot) │
└─────────────────┘
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                        FLEXBOT V2 - RESULTS SUMMARY
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ENVIRONMENT                    TRAINING                  PERFORMANCE
─────────────                  ──────────                ─────────────
• 4-segment planar arm           • PPO algorithm           • Final Success Rate:  12.0%
• Continuous action space      • 1000 episodes           • Final Avg Reward:  -68.82
• Full domain randomization    • Curriculum learning     • Eval Success Rate:  10.0%
• Realistic physics model      • GAE advantage estimation

KEY CONTRIBUTIONS
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✓ Demonstrated synthetic data generation via domain randomization
✓ Implemented PPO with GAE for stable robot control learning
✓ Applied curriculum learning for efficient training
✓ Created foundation for Sim2Real transfer
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