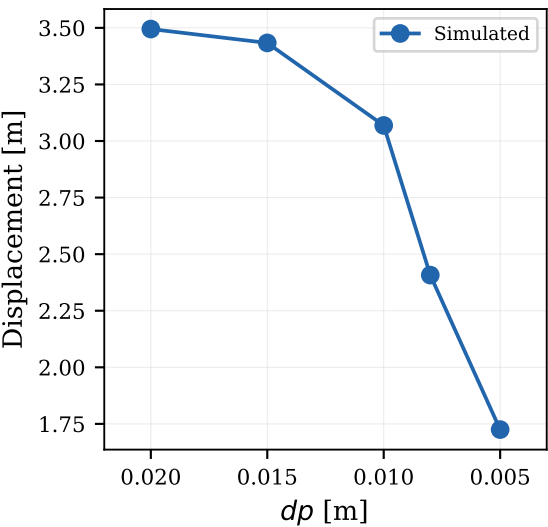**Mesh Convergence Study — Complete Analysis (5 resolutions, RTX 5090)**
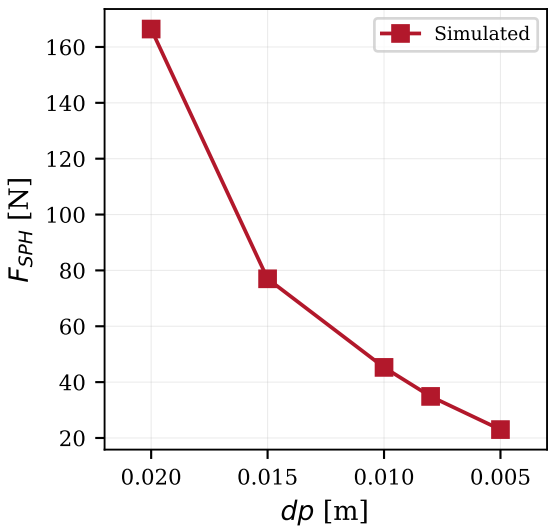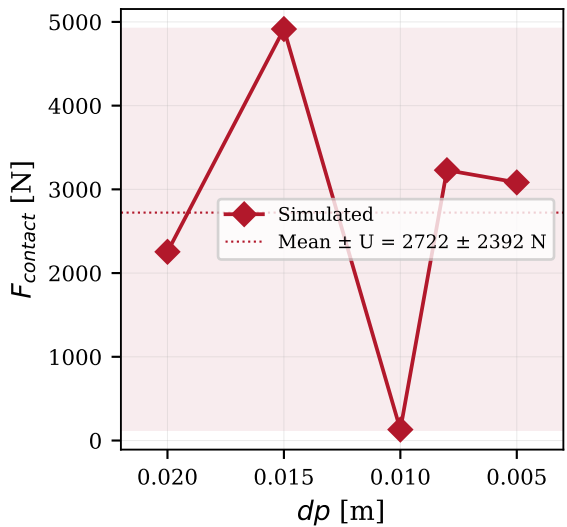
(a) Displacement — p=0.50
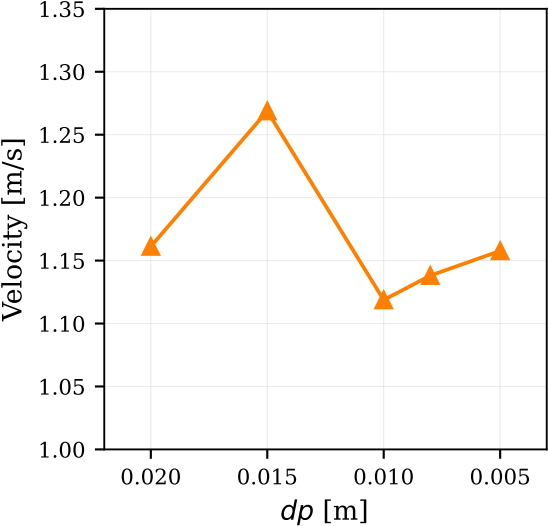
Displacement [m] vs dp [m]
- Simulated

(b) SPH Force — p=1.74

F_{SPH} [N] vs dp [m]
- Simulated

(c) Contact Force — monotonic divergence

$F_{contact}$ [N] vs dp [m]
- Simulated
- Mean ± U = 2722 ± 2392 N

(d) Boulder Velocity — oscillatory

Velocity [m/s] vs dp [m]

(e) Rotation — monotonic divergence

Rotation [deg] vs dp [m]
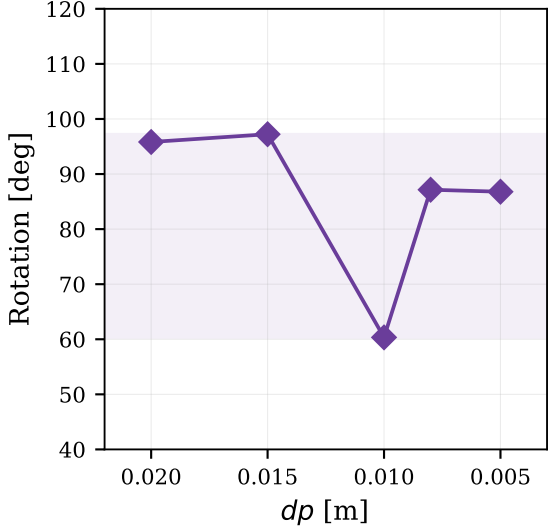
```
CONVERGENCE VERDICT
═══════════════════════════════════════
△   Displacement      monotonic_divergence
△   SPH Force         monotonic_divergence
○   Velocity          U=0.1 (6%)
△   Rotation          monotonic_divergence
△   Contact Force     monotonic_divergence
○   Flow Velocity     U=0.1 (11%)
───────────────────────────────────────
●  Monotonic convergence (GCI valid)
○  Oscillatory (uncertainty band)
△  Divergence
───────────────────────────────────────
Best triplet: dp = (4, 3, 1)
Total compute: 197 min
Hardware: NVIDIA RTX 5090
```