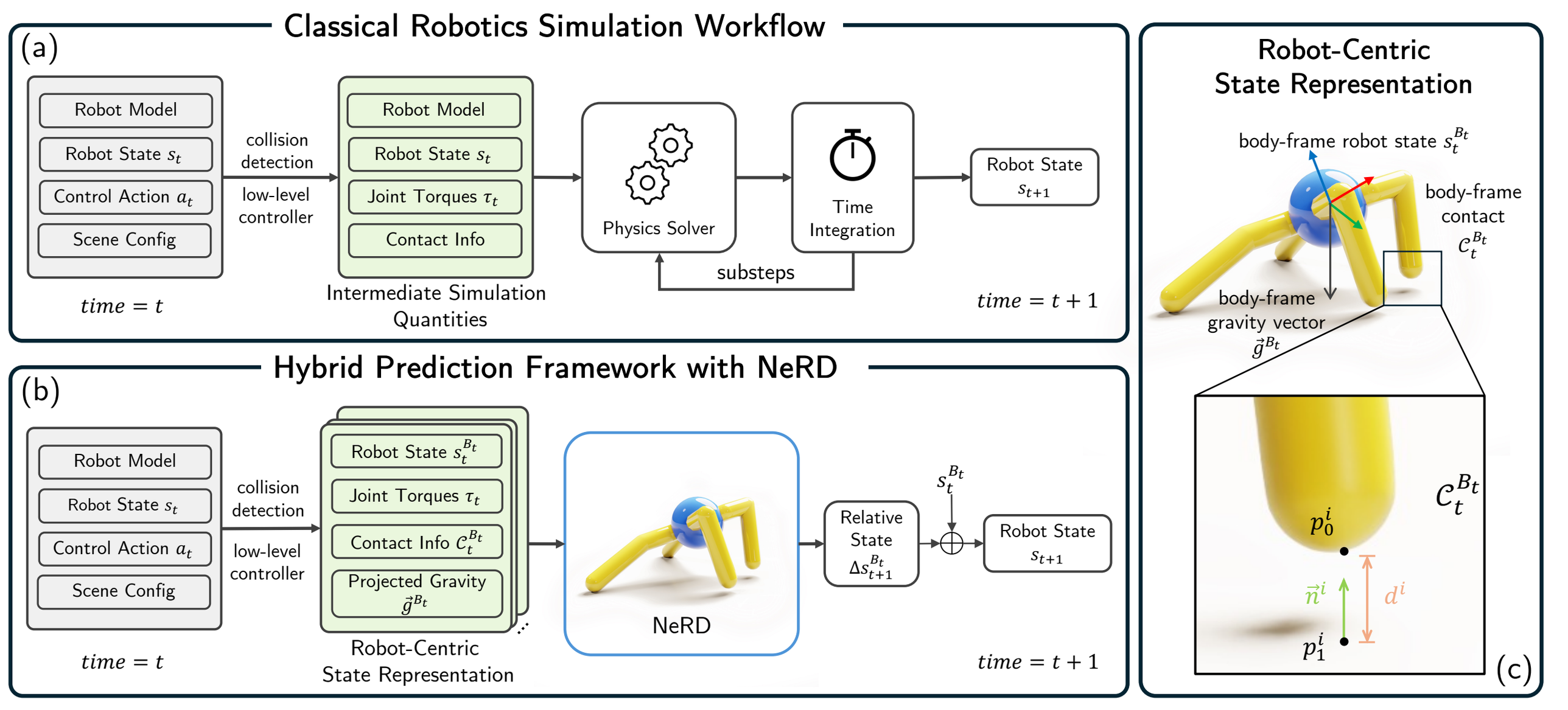
Classical Robotics Simulation Workflow
(a)
Robot Model
Robot State s_t
Control Action a_t
Scene Config
collision detection
low-level controller
Robot Model
Robot State s_t
Joint Torques τ_t
Contact Info
Intermediate Simulation Quantities
Physics Solver
Time Integration
substeps
Robot State s_{t+1}
$time = t$
$time = t + 1$
Hybrid Prediction Framework with NeRD
(b)
Robot Model
Robot State s_t
Control Action a_t
Scene Config
collision detection
low-level controller
Robot State $s_t^{B_t}$
Joint Torques τ_t
Contact Info $\mathcal{C}_t^{B_t}$
Projected Gravity $\vec{g}^{B_t}$
Robot-Centric State Representation
NeRD
Relative State $\Delta s_{t+1}^{B_t}$
$s_t^{B_t}$
Robot State s_{t+1}
$time = t$
$time = t + 1$
Robot-Centric State Representation
body-frame robot state $s_t^{B_t}$
body-frame contact $\mathcal{C}_t^{B_t}$
body-frame gravity vector $\vec{g}^{B_t}$
$\mathcal{C}_t^{B_t}$
p_0^i
$\vec{n}^i$
d^i
p_1^i
(c)