

Supplement to *Natural science: Active learning in dynamic physical microworlds*: Box2D settings for main experiment

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1 Box2D settings

Box2D is available here github.com/erincatto/Box2D and the javascript port is available here box2d-js.sourceforge.net.

Our demo code is available www.ucl.ac.uk/lagnado-lab/experiments/neil/apl/exp_2/demo.html and here: www.ucl.ac.uk/lagnado-lab/experiments/neil/apl/exp_2/physics_world_exp2.html. After landing at these locations, right click to view the source code.

Below is a list of the Box2D variables and functions set in our main experiment code:

- Number of steps (frames): 2700
- Trial length = 45s
- Box2D step size: 1/60s ($\approx 17ms$)
- Ratio (pixels to meters): 100 (200 on retina screens)
- Object velocity cap: 30 m/s
- Criterion for refreshing puck locations and velocities: Fastest object is moving at less than 0.25 m/s
- Pause time if locations refreshed = 500ms
- World width: 6m (600 pixels / 1200 on retina screens)
- World height: 4m (400 pixels / 800 on retina screens)
- Global forces: None
- Attractive forces: $+3 \text{ m/s}^2$
- Repulsive forces: -3 m/s^2
- Controlled object attraction to cursor: $.2 \times \text{distance}(\text{cursor}, \text{controlledobject}) \text{ m/s}^2$
- Controlled object damping: 10^1
- Puck masses: 1kg (or 2kg for heavy target ball)
- Puck friction: $.05^2$
- Puck elasticity: .98
- Puck damping: .05

¹Damping in Box2D slows objects while they are not in contact with any other objects (like wind resistance). The controlled object was given high damping so it would not oscillate for a long time around the cursor location.

²Friction in Box2D occurs when two objects slide past each other while touching (e.g. a puck sliding along a boundary wall).

- Puck radius: .25 m
- Puck object types: Dynamic
- Wall mass: n/a
- Wall friction: .05
- Wall elasticity: .98
- Wall damping: n/a
- Wall width = .2m
- Wall object types: Static