Modeling Interations

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Motivation

Consortium for Wildlife Bycatch Reduction

- How do whales become entangled in fishing gear?
- What are the added drag forces on the whale?
- Can we model whale interaction with different gear configurations?
- What can we learn from observed entanglements and the gear involved?

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What are we doing?

- Developing and using an interactive (game -style) whale- fishing gear entanglement computer modeling program.
- Reverse engineering whale behavior given observed entanglements.
- Generating computer animations of possible entanglement scenarios.
- Studying forces whale places on fishing gear.
- Studying forces fishing gear places on whale.

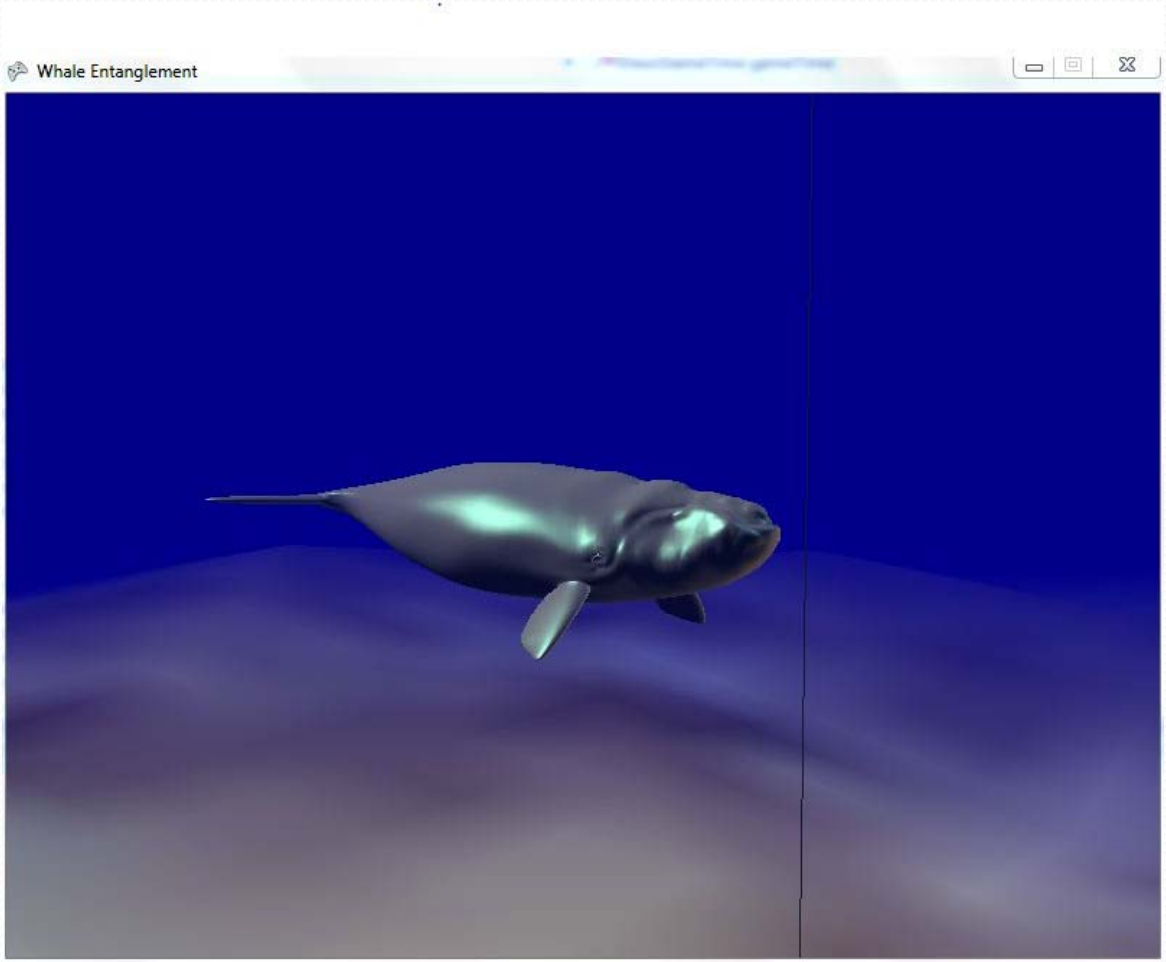
How are we doing it?

- Custom written computer program for Windows computers and Xbox 360 gaming consoles (XNA 4.0).
- Generate models of whales.
- Calculate collision between whale and fishing gear.
- Use rope physics to model the rope-whale interaction.
- Use case studies of post-entangled whales to recreate possible whale behavior leading to that entanglement.

Why a game-style program?

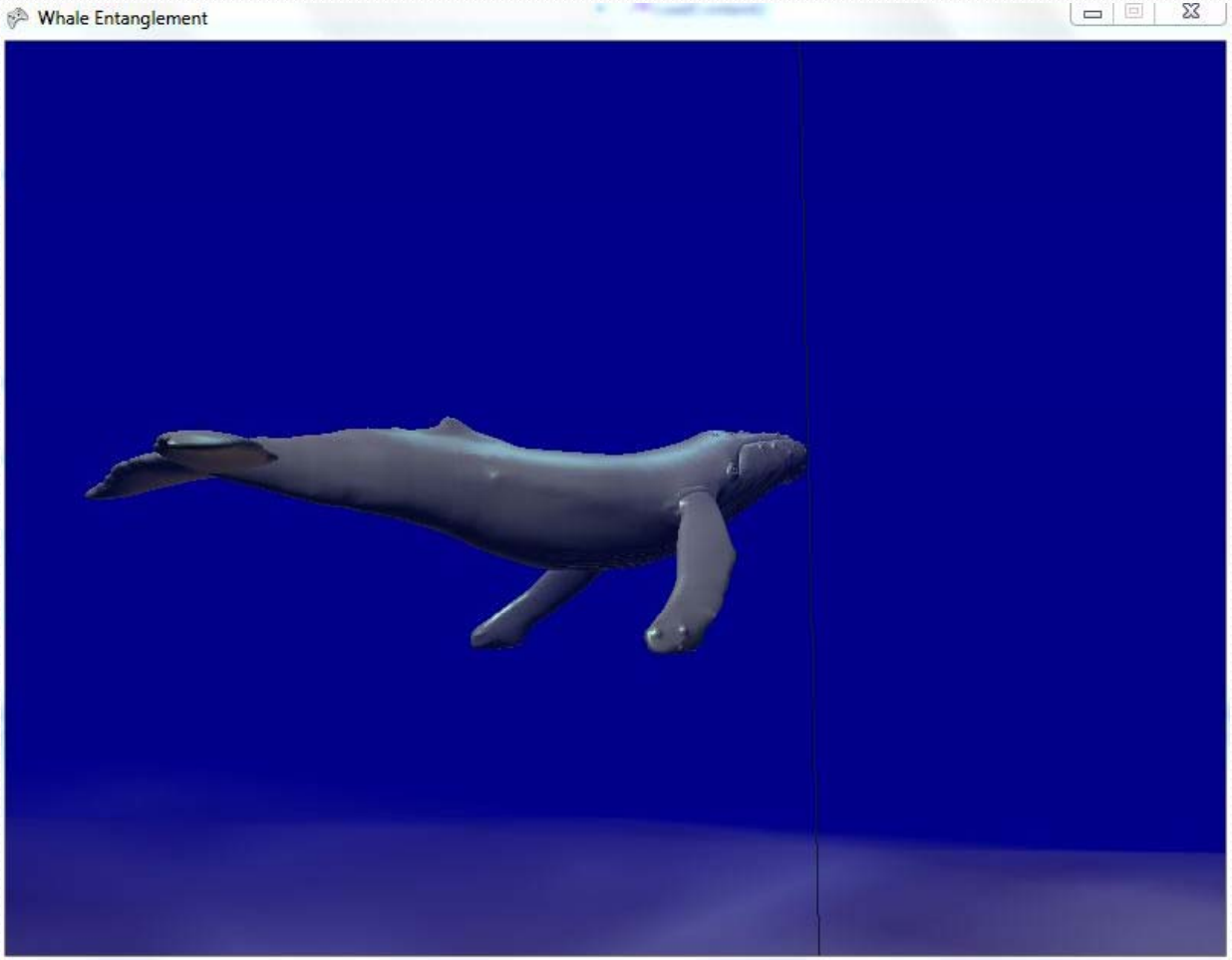
- Computer games are multi-physics simulations of events in the real world (but highly scripted and simplified).
- We know some (but not much) about how whales react when encountering fishing gear so we cannot "program" the whales' behavior.
- Allows user to examine multiple "what-if" scenarios.

The whales – right (our whale)

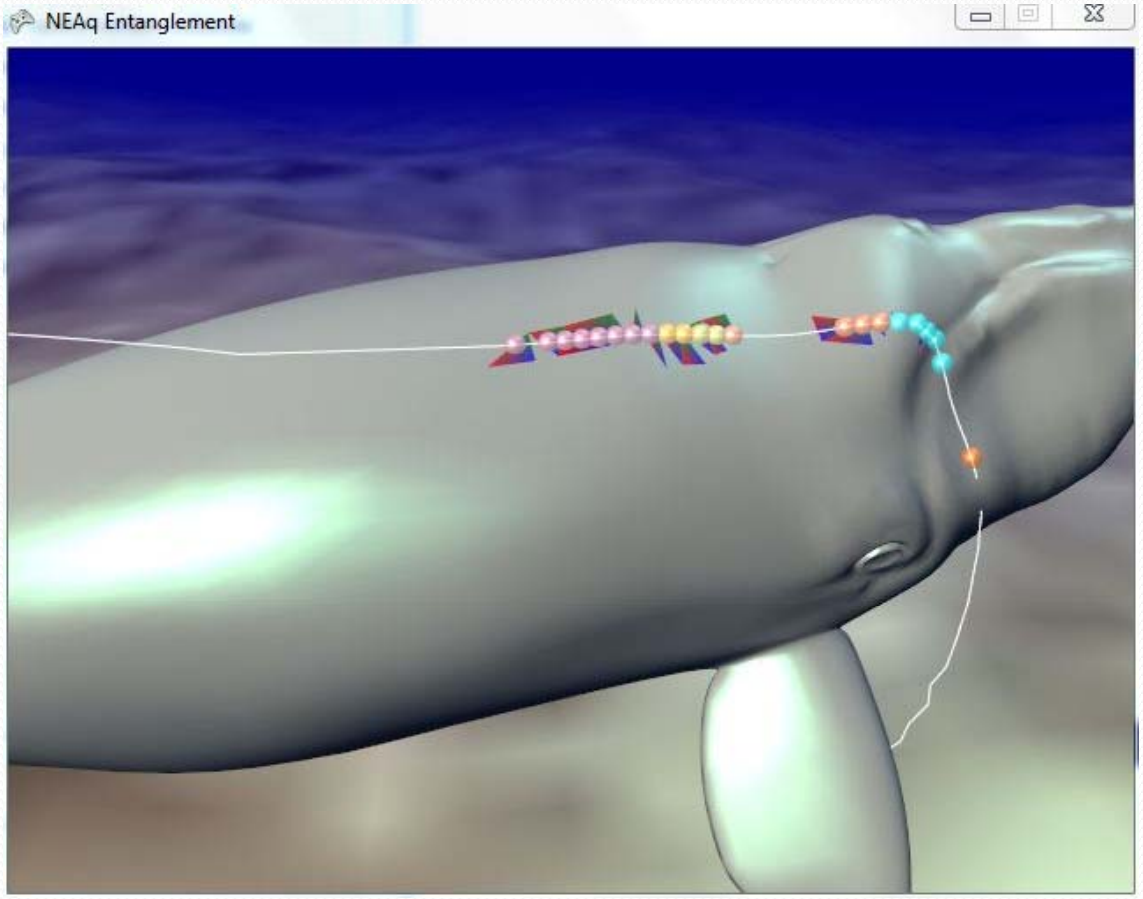


Feeding right whale

Humpback whale

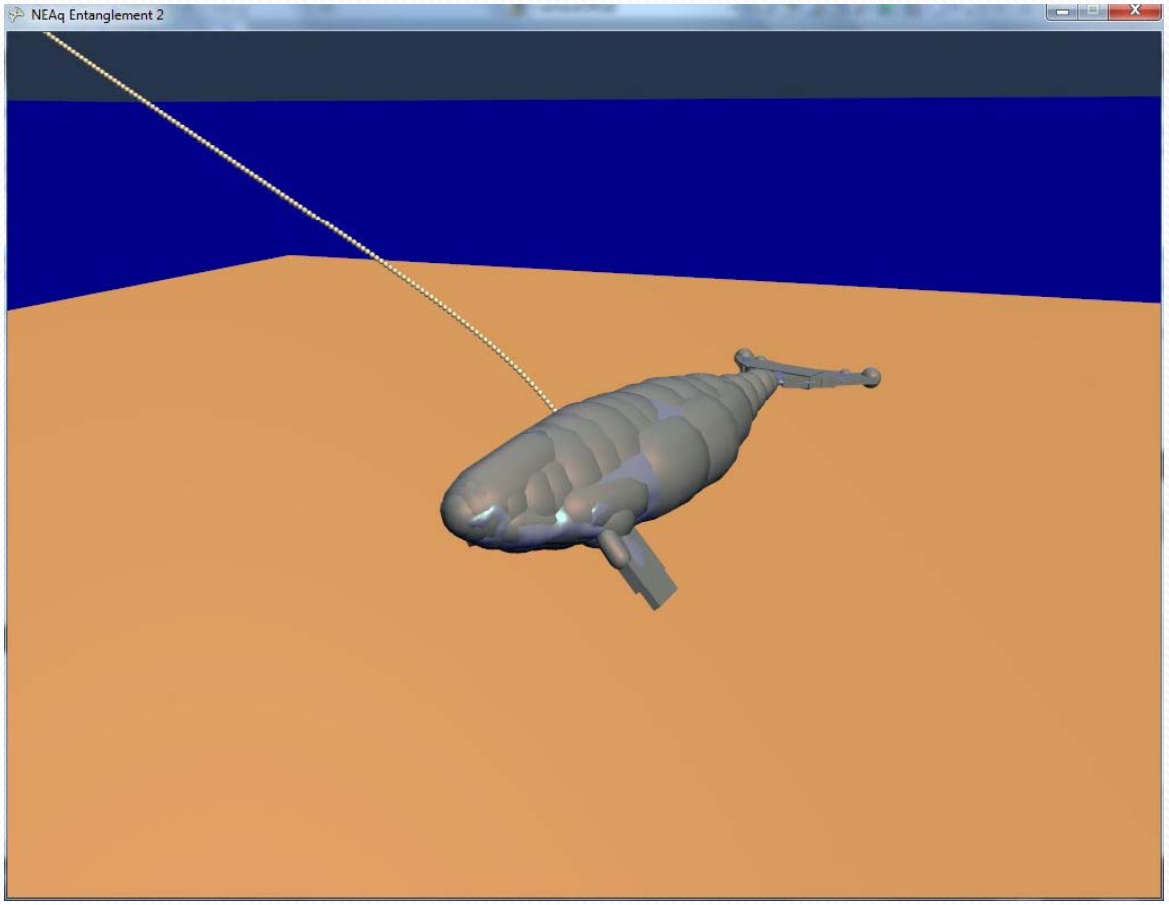


The collision problem



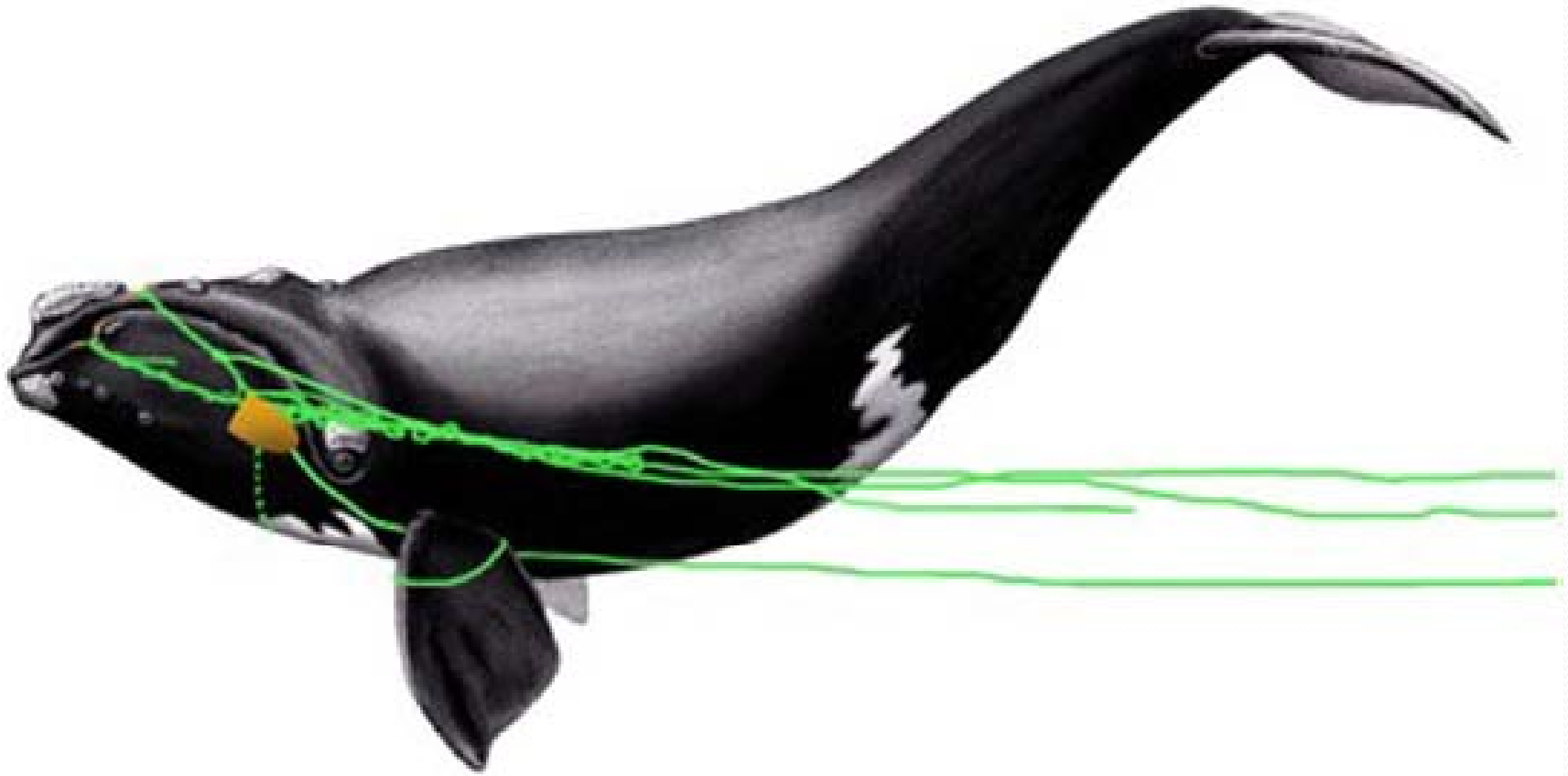
Difficult collision program

An easier collision problem



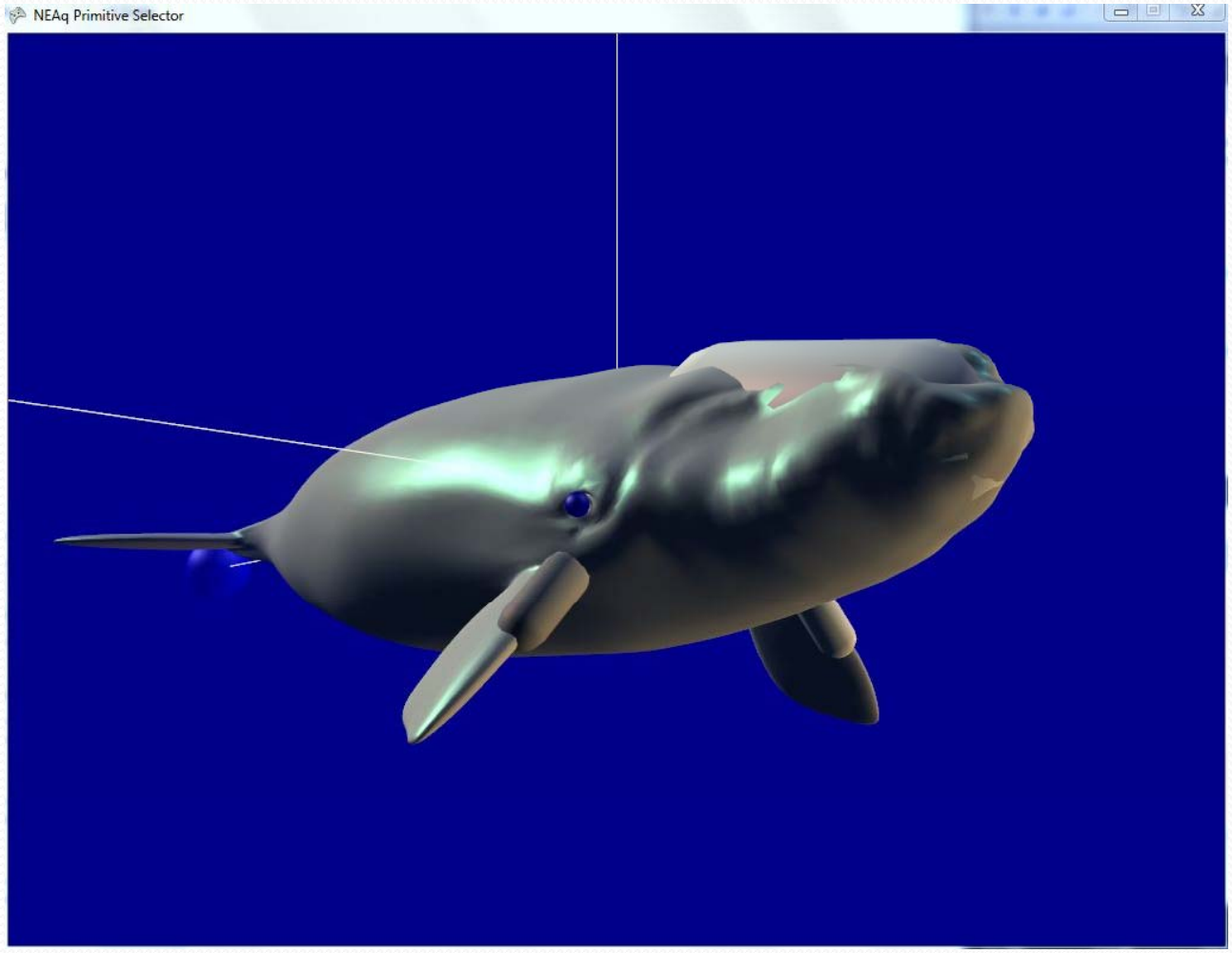
Primitive selector program

The problem wrap areas*



*I stole this image from Doug Nowacek, who stole it from Scott Landry

Problem areas as sticky spots



Rope physics*

- Rope engineering (Hank, John, Tim, Amy, Scott L.)
- Rope diameter
- Breaking strength
- Floating/sinking
- Stiffness
- Friction
- Color - can a whale see it (Jeffry Fasick)

*Tim said he will cut my pay by half for each equation I show.

An easier rope problem

- Discrete segments (spheres, links)
- Virtual springs connection links
- Self collision detection
- Can add stiffness but probably not necessary with damping and drag from water.

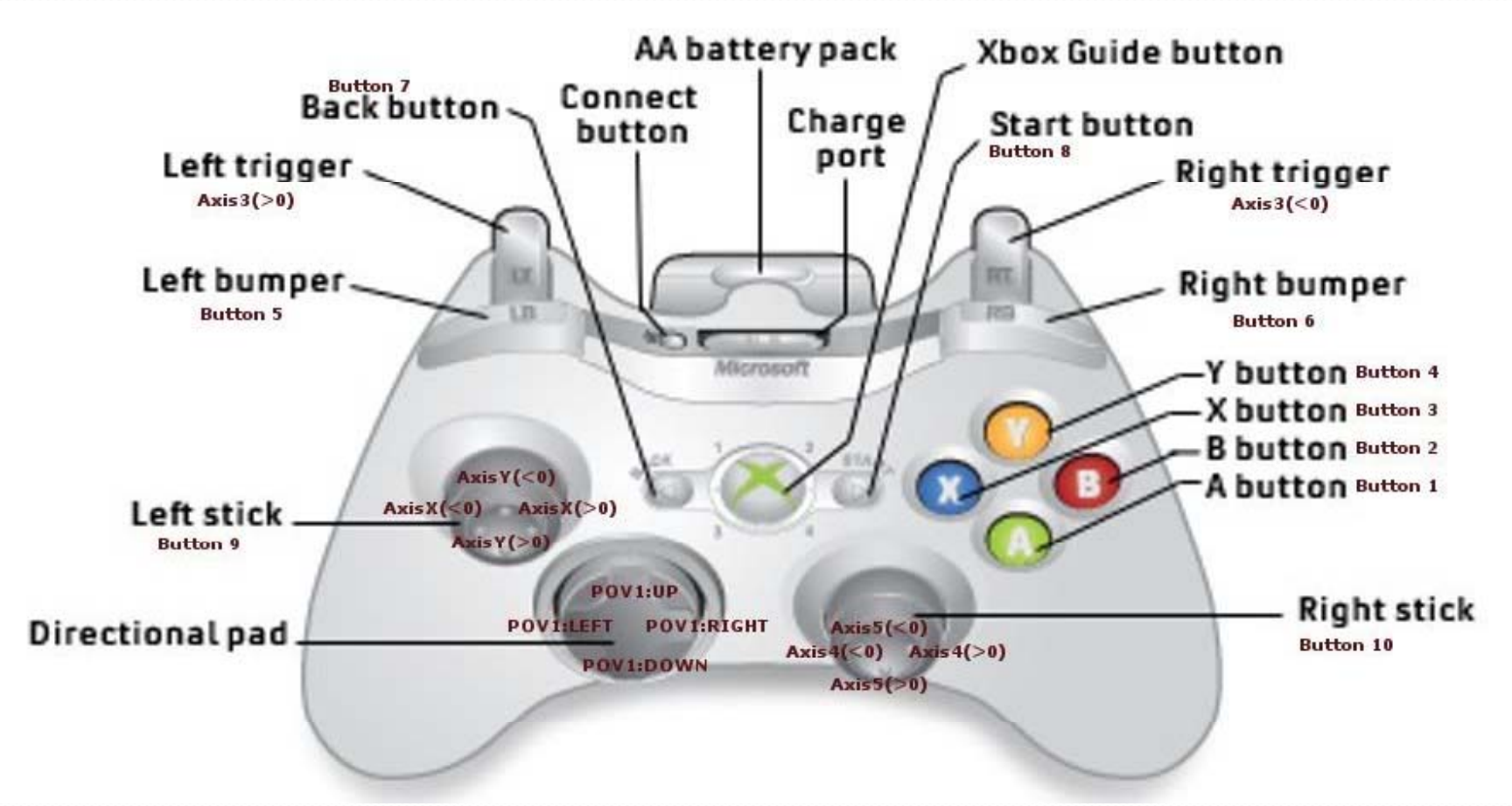
Simplified rope program

Gear configurations

- Singles (size weight)
- Multiples (how many, how far apart)
- Anchors
- Floats/markers
- Floating/sinking ropes
- Weak links
- Please give me your input on what types and configurations of fishing gear it would be useful to model.

Multiple trap program

The controls

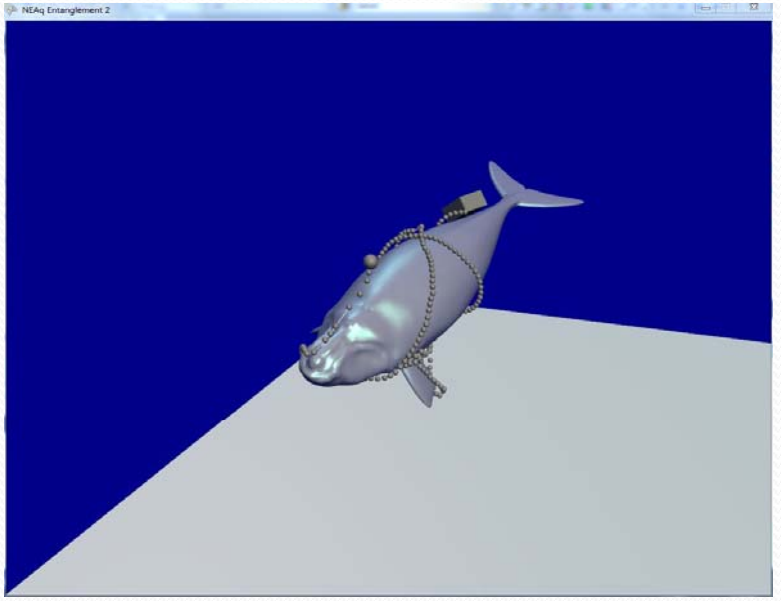


Controller keys

- *Left trigger*: swim forward
- *Left joy*stick: pitch up/down – roll left/right
- *Right joystick*: turn left/right
- *Right shoulder (bumper) button*: swim or turn fast
- *Start button*: restart the simulation
- *Back button*: exit the program
- *B button*: toggle first/third person (whale) view
- *Y button*: break trap-line at trap.
- *A button*: loose sticky rope.
- *Vibrates*: if whale gets too close to seafloor or surface

Capabilities

- First/third person (whale) point of view
- Moving the whale move to position then go slow
- Colliding the rope – sticky areas
- Tunneling problem of whale swims too fast
- Simulating a lost trap
- Flipper wraps
- Fluke wraps
- Controller feedback



Modeling system demo

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Conclusion

- Research version to include detailed physics simulations .
- Please give feedback on features you would like to see added to the modeling system.
- Let's see if we can figure out how some of the entanglements happened.

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