Gamification of shallow geosteering

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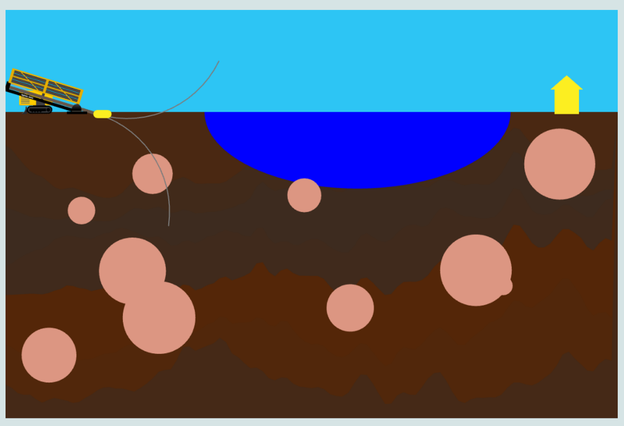
Motivation

Horizontal directional drilling (HDD) is a go-to method for installing subsurface pipelines, telecommunication cables, power lines, and sewers without digging trenches. The traditional methodology follows a pre-defined path to drill a horizontal well under surface obstacles such as rivers or inhabited areas. In the last few years, logging-while-drilling (LWD) measurements developed for oil and gas drilling have become more affordable and made their way to civil drilling. They enable shallow-well geosteering [2, 5]: intentional real-time trajectory adjustment to adapt to the observed subsurface environment.

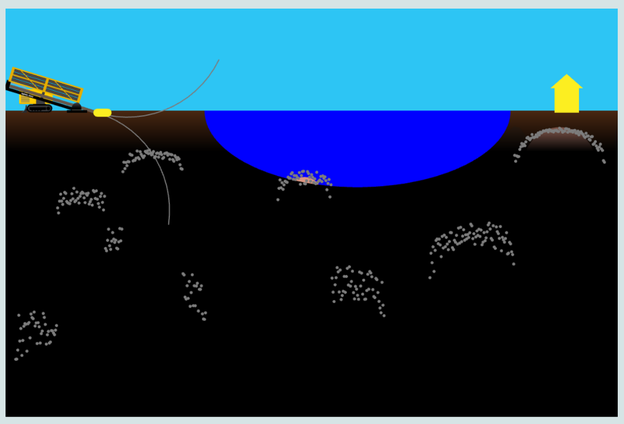
Underbore [3] is an open-source game created to explain HDD and geosteering and some of their challenges to a wider audience [4, 1]. We seek **collaborators** and **new ideas** for developing Under-Bore further.

Layers of complexity

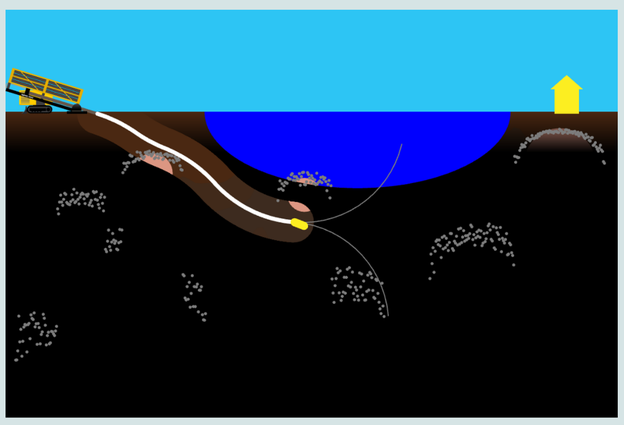
As a player, you are challenged to Under-Bore the river in 2D by only controlling the bit's bias, either up or down, and hence the drilling direction.



You must avoid subsurface obstacles hidden behind the "fog of uncertainty". In the pre-drill stage, the obstacle tops are detected by seismology and shown as dots.



As you start drilling, the fog clears following the bit, simulating an LWD tool with a limited look around.

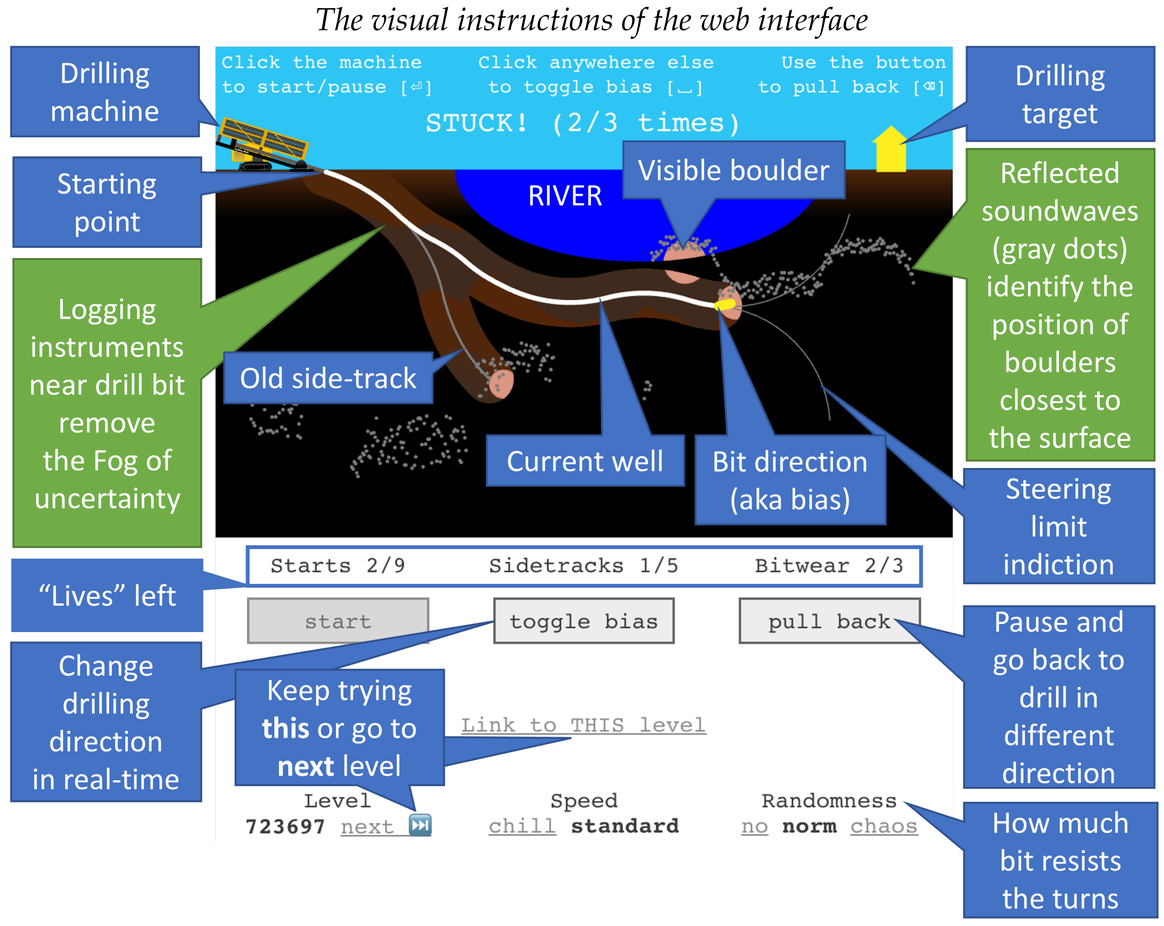


If you hit a boulder, you can pull back on the pipe and try drilling in another direction. But the drill bit will get broken after three collisions.

Instructions

The elements of the web interface are explained in the figure below.

The visual instructions of the web interface



The final score accounts for the total length drilled, the final length of the well, and the number of stuck times. Participants can share scores and replays as a link on any digital medium.

Try it yourself

Try getting the best score for the level.

https://al-digital.no/Directional-Boring/?seed=534608

Today's Scores

Conclusions

- Under-bore shares challenges and excitement of HDD and geosteering in a playable manner
- In four months, the project organically attracted about ten contributors from the open-source community [6]
- Scalability and replay-share feature potentially allows guided AI training

References

[1] G. Hillhouse and Practical Engineering. How do you steer a drill below the earth? https://www.youtube.com/watch?v=JAhdb7dKQpU, 2022.

[2] E. P. Johnson, E. Morley Beckman, C. Goss, K. Guy, and R. Burton. Using directional drilling techniques to intersect the american tunnel. In *Rocky Mountain Geo-Conference 2021*, pages 99–109. ASCER, 2021.

[3] D. Shiffman, S. Alyaev, Denisovich, ArztKlein, and tyomka896. alin256/Directional-Boring: v0.9. Horizontal Directional Drilling Simulation Game, 2022.

[4] D. Shiffman and The Coding Train. Coding challenge 172: Horizontal directional drilling. https://www.youtube.com/watch?v=FfCBNL6lWK0, 2022.

[5] P. Ungemach, M. Antics, D. Di Tommaso, and F. Casali. Real time geosteering integrated services. a key issue in maximizing geothermal exposure... In *SPE/IADC IDCE*, 2021.

[6] https://github.com/CodingTrain/Directional-Boring

Acknowledgments

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