Offshore Cable Burial
How Deep is Deep Enough?

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ABSTRACT

Context
Subsea power cables are essential to connect offshore renewable energy installations to electricity networks, to transfer power within networks and interconnect national networks. These cables are at risk of accidental damage; 2024 analysis showed that 70% of subsea cable damage is caused by anchors/fishing gear.

Cable Protection
The primary way to protect a subsea cable from anchor strike is to bury it below the seabed. The burial depth is a compromise between providing sufficient protection and the increasing cost of burial as depth increases. The standard approach to specify the burial depth is the Carbon Trust's Cable Burial Risk Assessment (CBRA) framework, which estimates the penetration potential of an anchor through seabed factors. These are broad classifiers that do not consider the variability within the groups or the potential for layers of different sediment types.

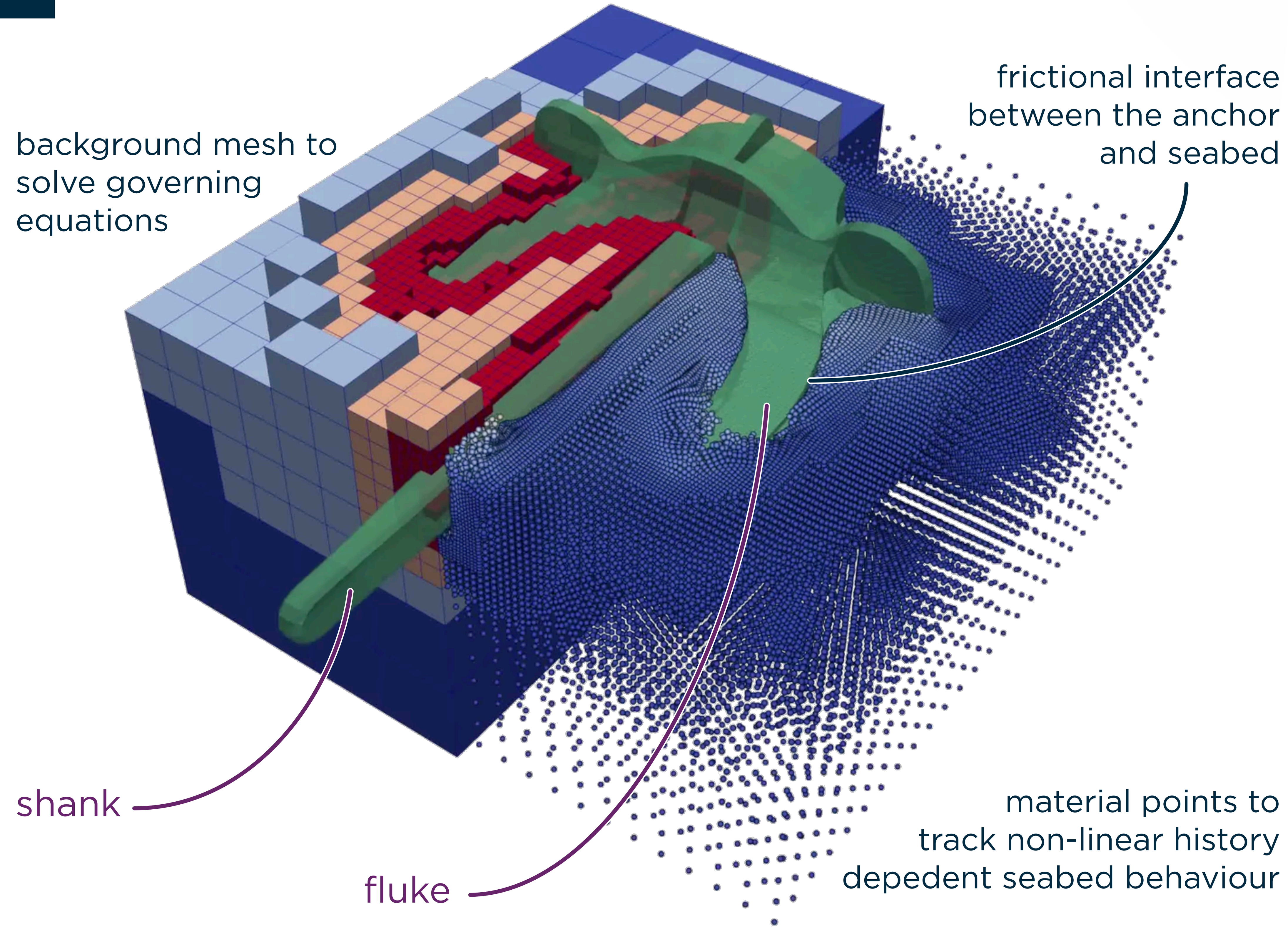
"industry as a whole would benefit from further research into anchor penetration in a range of seabed types"

Methodology
Seabed characterisation combined with centrifuge physical testing and advanced numerical modelling to provide enhanced guidance on likely anchor penetration depths in different seabed conditions.

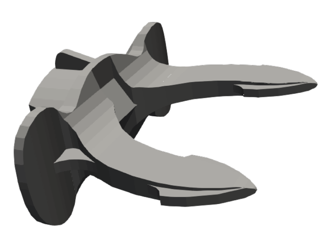
Results
Anchor penetration depths are highly dependent on seabed conditions and anchor geometry. Penetration depth scales linearly with anchor fluke length. Behaviour in layered seabeds is complex, anchor geometry dependent and site specific.

Conclusion
Overall, this project provides key insights and data for the next generation of CBRA approaches to better protect subsea cables.

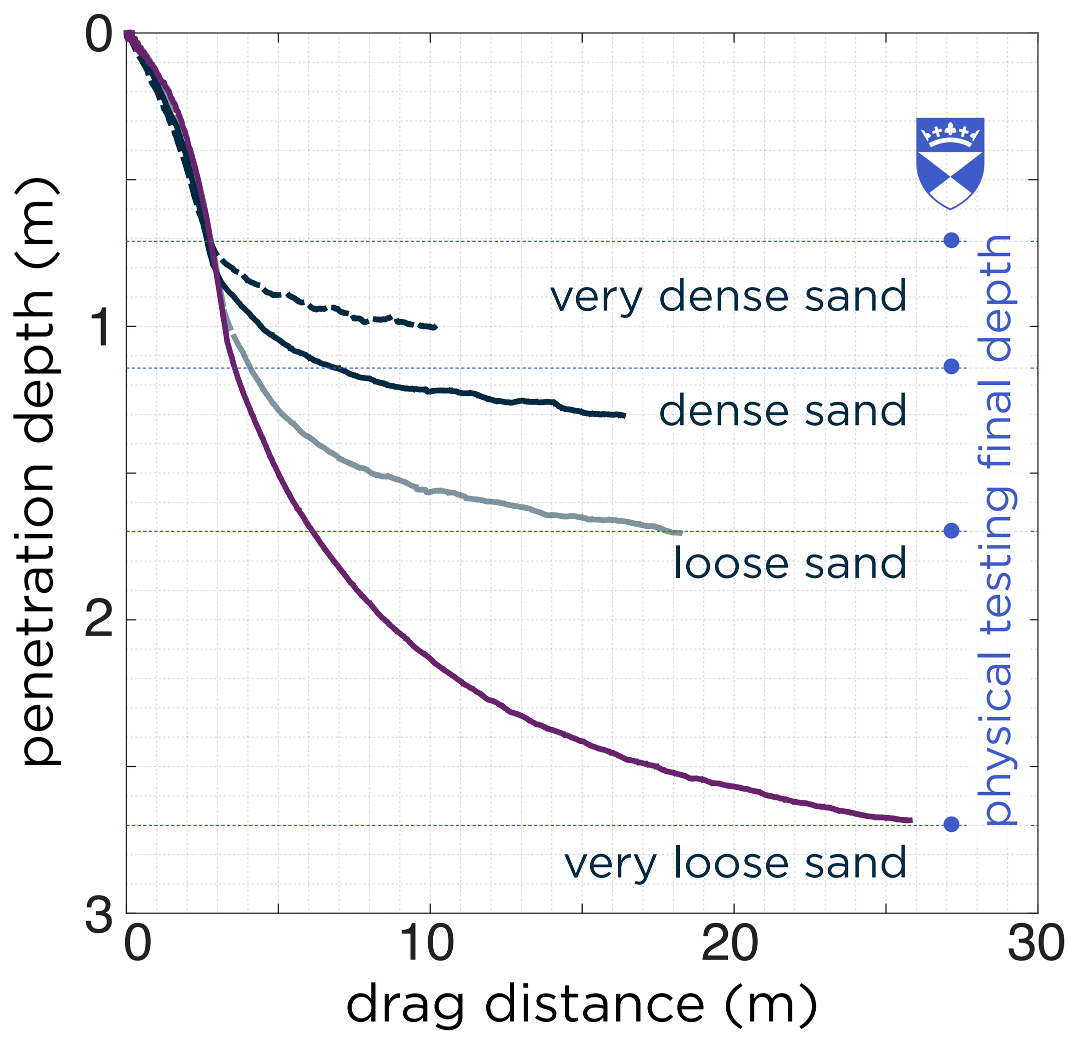
1 Methodology: Material Point Method for soil structure interaction



2 Results: Seabed state

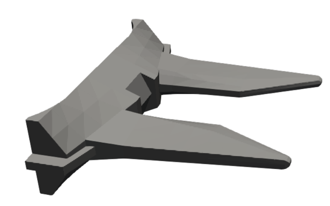


Hall anchor, impact of seabed state, validation with physical testing

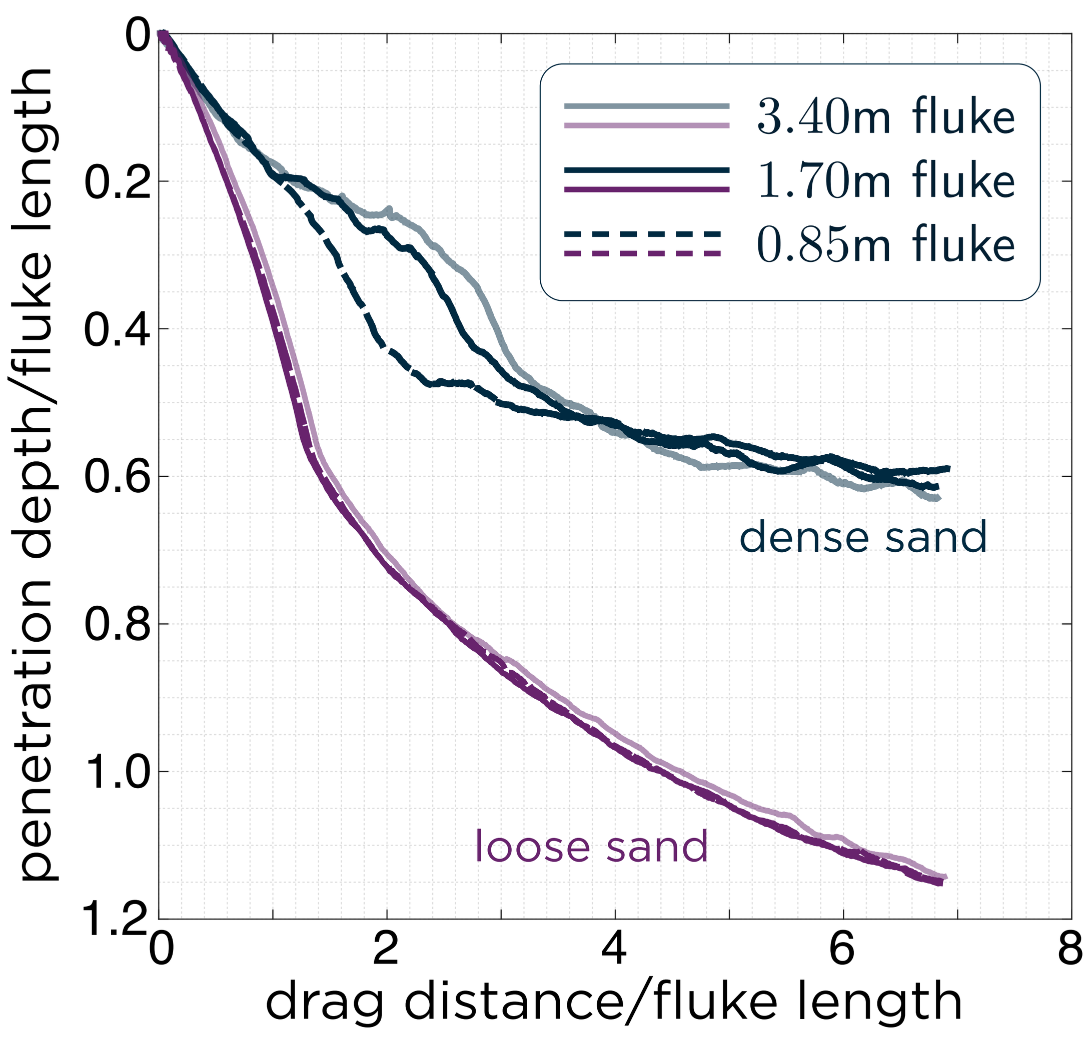


- Anchor penetration is highly dependent on sand relative density.
- Numerical predictions validated through physical testing.

3 Results: Anchor size



AC-14 anchor, impact of anchor size in two seabed states



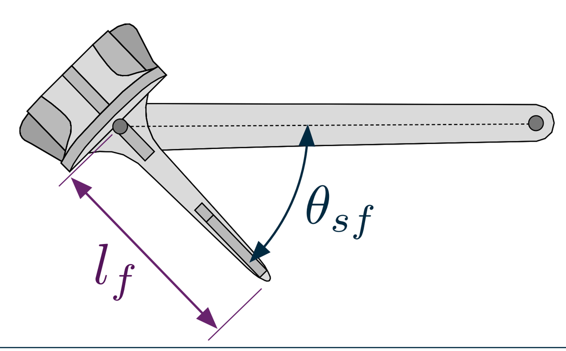
- Anchor penetration scales linearly with fluke length.
- Penetration is dependent on the full anchor geometry, not just fluke length.

4 Practice: Cable burial implications

$$d_p = S_f \ \sin(\theta_{sf}) \ l_f$$

CBRA anchor penetration predictions, d_p, incorrectly assume a common seabed factor, $S_f = 1$, for all sand seabeds.

Numerical modelling and physical testing have determined sand sebed factors between 0.8 and 3.6.



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Funded by UK Research & Innovation grants EP/W000970/1, EP/W000997/1 and EP/W000954/1

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