The effect of Winch Line stiffness on the motion response of a Remotely Operated Vehicle (ROV) during Launch and Recovery

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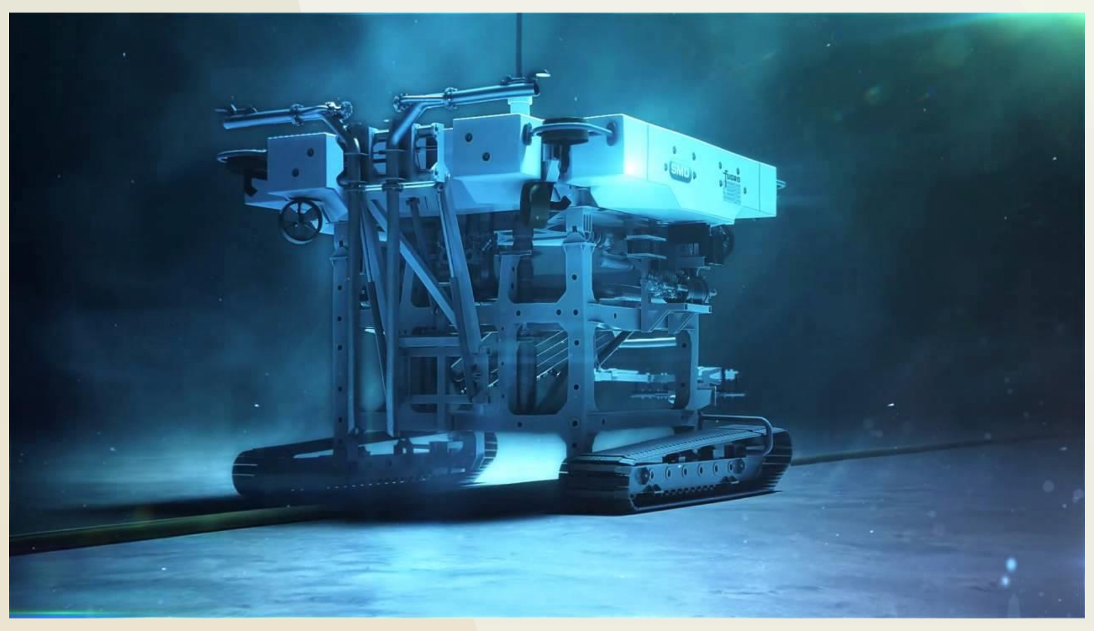
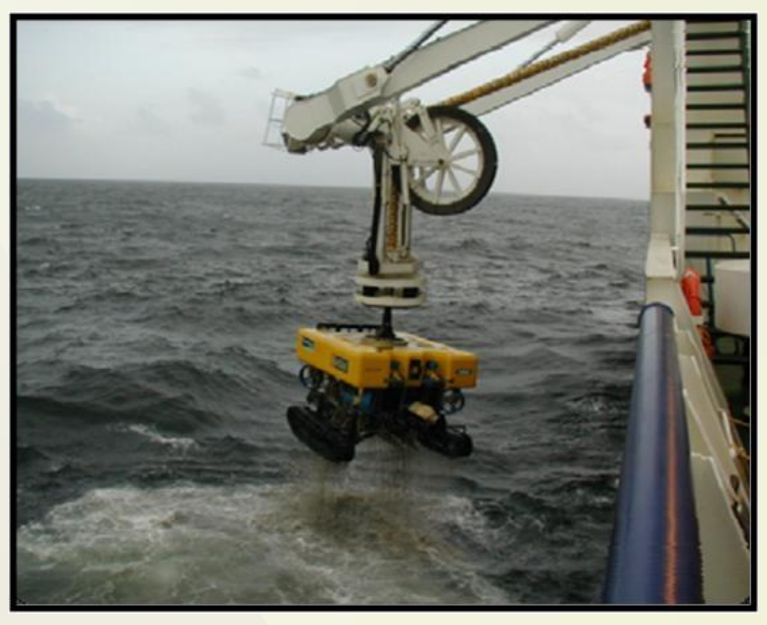
Introduction

Remotely operated vehicles (ROV) are essential tools used in the development and exploration of seabed resources. This includes mining seabed minerals, servicing offshore hydrocarbon production facilities and surveying the subsea environment. ROVs are useful for any underwater environment that is beyond human reach.





The deployment and recovery of ROVs are usually done using handling structures (A-frame) mounted on a support vessel and winches (with wires) and a cursor fitted onto the wires for control purposes.

When the ROV is entering or leaving the water surface (Splash Zone), there is a large change in buoyancy of the ROV. Insufficient tension on the winch wires can lead to excessive movement of the ROV and can damage equipment or the ROV. It might delay the whole operation or in the worse case, loss of the ROV.

Aims & Objectives

Aims:

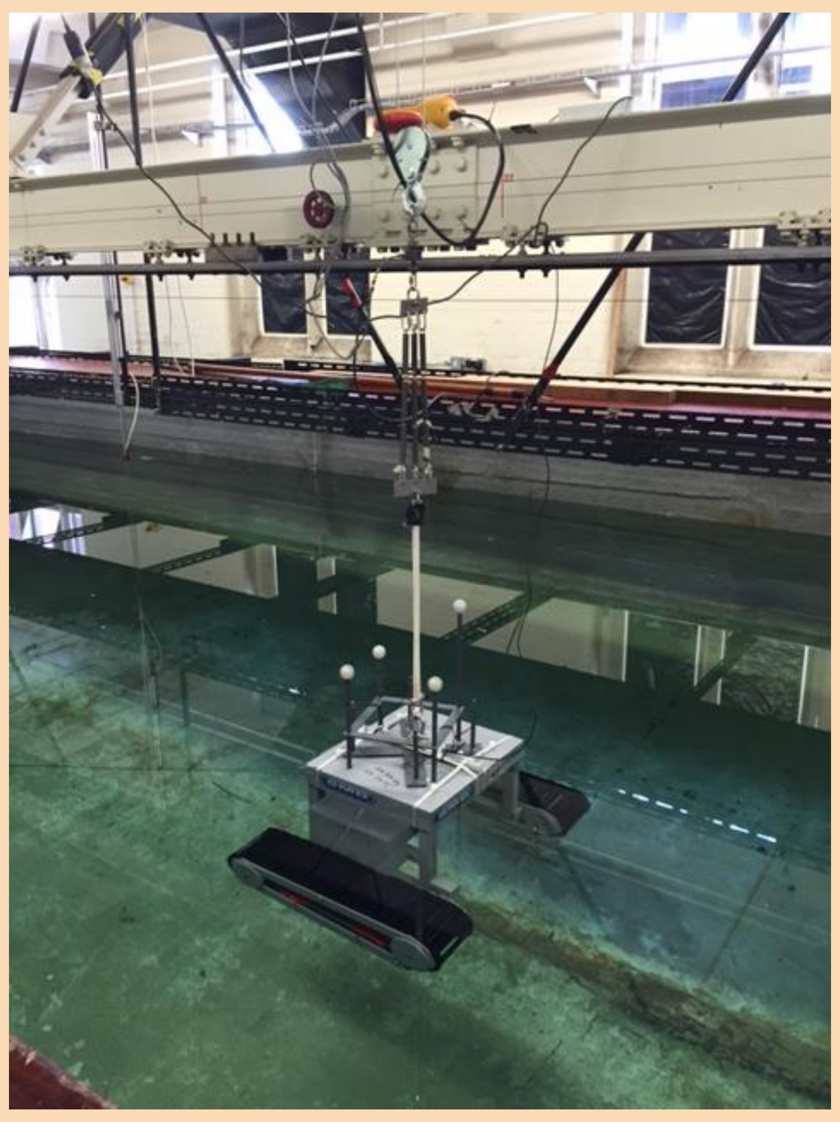
- To quantify the effects of changing the winch wire stiffness on the motion response of a ROV during launch and recovery

Objectives:

- To conduct dynamic experiments to predict motion response of the ROV with a given wire stiffness during key stages of the launch and recovery process.

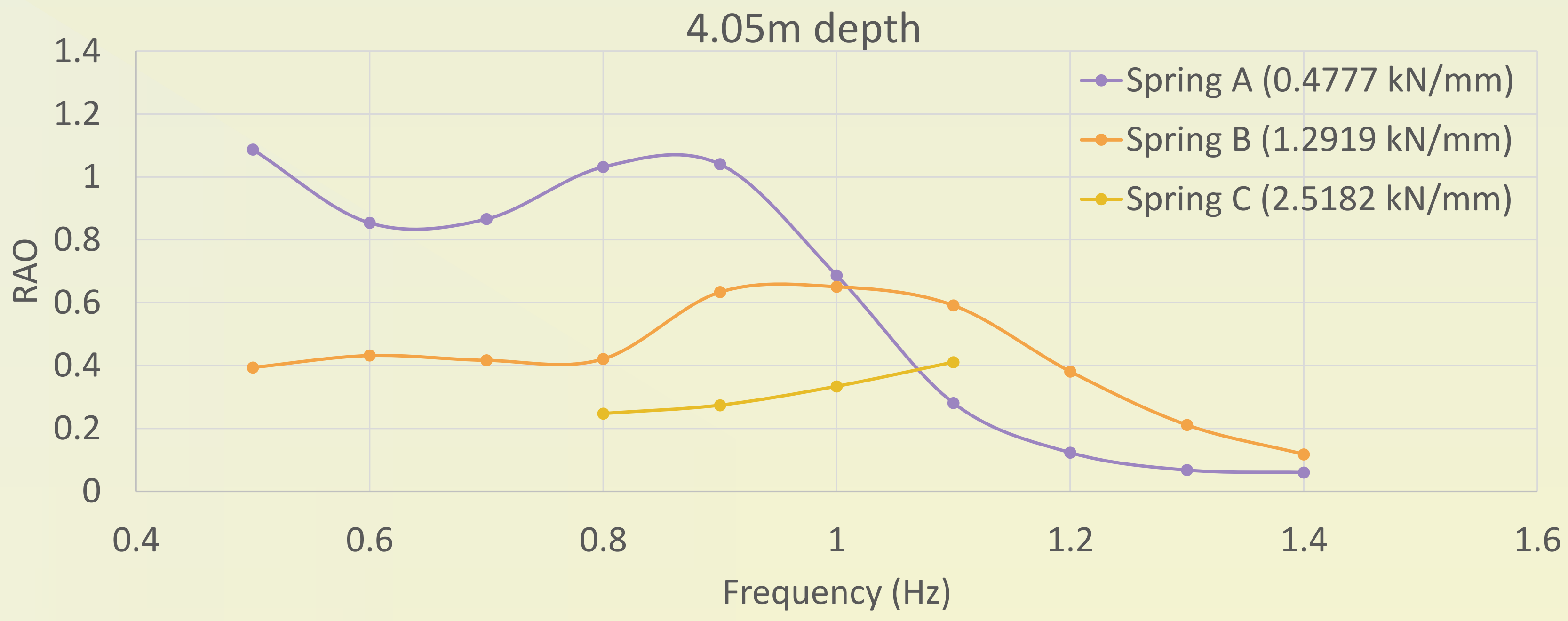
Experimental Testing

- Newcastle Univeristy Towing Tank
- 3 sets of springs used to represent wire stiffness
  - Spring A: Soft. K=0.48N/mm;
  - Spring B: Medium. K=1.29N/mm;
  - Spring C: Hard. K=2.52N/mm.
- 2 submerged depths
- Wave frequencies: 0.5Hz – 1.4Hz
- Motion response captured using Qualysis
- Heave RAO (Response Amplitude Operator) calculated



Results & Discussions

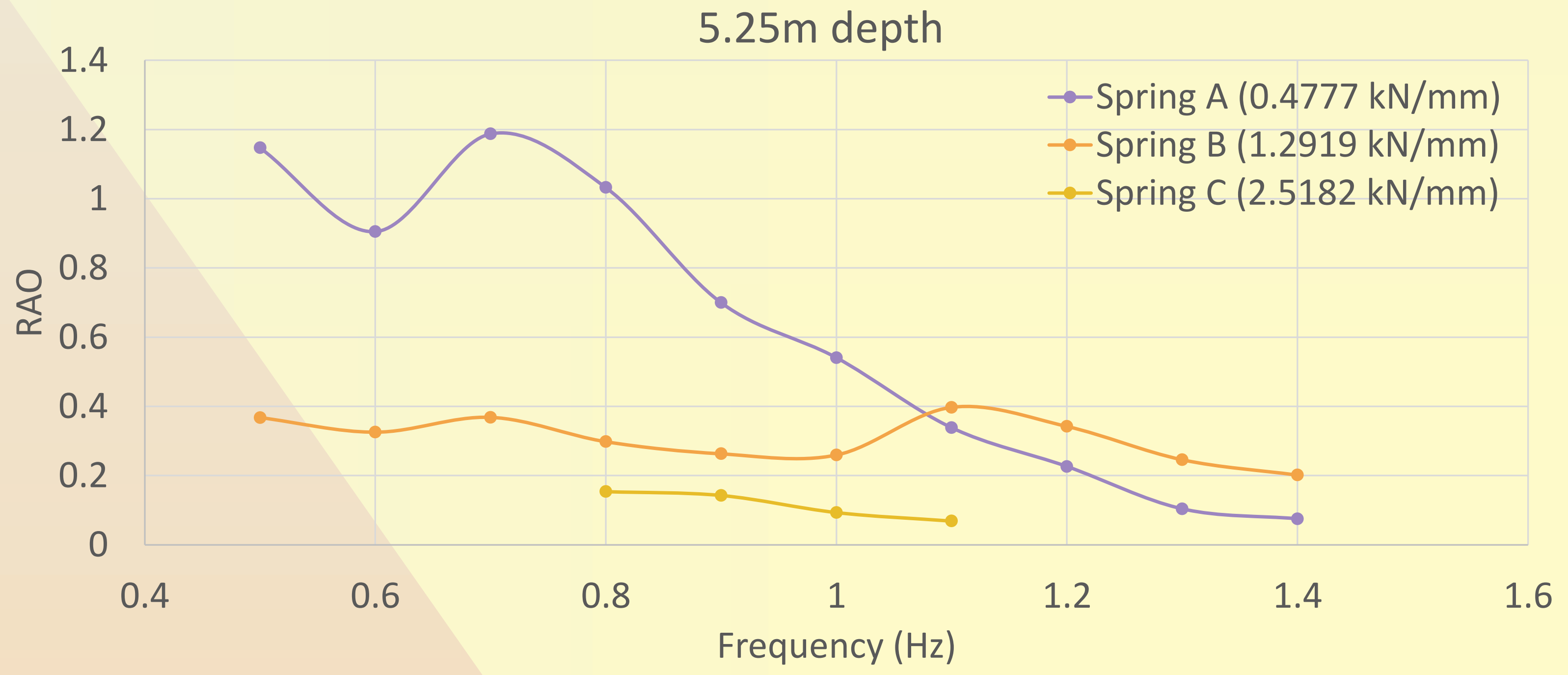
4.05m Submerged Depth:



Spring	Peak Magnitude (RAO)	Frequency (Hz)
A	1.0405	0.9
B	0.6509	1.0
C	0.4107*	1.1

- Increasing spring stiffness:
  - Decrease magnitude of response
- Phase shift towards higher frequency

5.25m Submerged Depth:



Spring	Peak Magnitude (RAO)	Frequency (Hz)
A	1.1876	0.7Hz
B	0.3974	1.1Hz
C	0.1539	0.8Hz

- Increasing spring stiffness:
  - Decrease magnitude of response
- Due to limited results, no clear trend to how response pattern changed

Conclusions

1. Increasing spring stiffness results in a decrease in magnitude of response
2. Response at high frequency is similar regardless of spring stiffness
3. Results do not give adequate understanding on how spring stiffness affects response pattern