WAVE

Advanced Motion Compensation System

Q&A

X-Wave™ Questions Answered ...

Q: What is X-Wave™

A: X-Wave™ is a modular, adaptive and self-learning Active Heave Compensation (AHC) Control System that can be easily retrofitted to existing lifting equipment or supplied to new equipment to provide AHC functionality.

Q: What does it include?

A: It includes: a high performance motion reference unit (MRU) that measures vessel pitch, roll and heave; a fast real time deterministic controller that interprets vessel motion from the MRU and uses sophisticated adaptive predictive algorithms to generate the compensation signals; ergonomic HMI for operator interaction; datalogging & remote access.

Q: What can it control?

A: It can control both rotary and linear compensators, for example winches and cylinders, with either hydraulic or electric drive. All common control system interfaces are provided to enable fast and simple interfacing to existing or OEM control systems.

Q: What does it cost?

A: Between £30,000 to £50,000 (X-Wave™ AHC Control System only) depending on the specification and features required.

Q: What are the benefits?

A: Self learning, minimum commissioning, low cost of implementation, high performance, accurate, universal, proven.

Q: What is the limiting performance factor?

A: Power & Dynamic Performance of the machine. A common misconception with AHC is that the power required is determined only by the power needed to overcome the inertia of the winch drum, to accelerate it in equal and opposite direction to the vessel heave. That's partially true but not the whole story. In fact the power is determined mainly by the load (force) and the work done moving it through a certain distance in a certain time.

Q: But if AHC is working the load doesn't move! After all isn't that the point of AHC?

A: Yes and No. This is a common misconception. The load doesn't move relative to the seabed, but the load **does move** relative to the vessel and the winch is on the vessel supporting it. When you move a load (force) through a distance in a time, work is done and if that distance is large and the time is short, then a lot of power is required. So although the load is stationary relative to the seabed, it's moving quickly relative to the vessel.

Q: How much power is needed?

A: It depends on the load, the winch drum inertia, and the heave accelerations that need to be compensated for. Generally a simple sinusoidal waveform can be used to estimate the powers required and a typical modelling waveform would be something like +/-2.5m heave amplitude (peak to trough) with a 10s period (peak to peak), so a distance moved of 5m in 5s.

Neglecting winch drum inertia, a 100Te load with a safety factor of 1 will require about 1.5MW of peak power to achieve this compensation performance!

A frequent mistake made when calculating AHC power is that the work is calculated at a constant rate over the time taken to move the load over the distance. In this case +/-2.5m amplitude, so a distance of 5m in 5s. This is not valid as the motion is periodic and peak powers are significantly higher than the average values calculated, requiring significantly more peak power than the simple constant work calculation would suggest.

www.activeheave.com xwave@activeheave.com

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Q: How can I reduce the power needed to achieve good performance?

A: By capturing and storing the energy produced during the 'render' phase and releasing it again during the 'recovery phase'. When the ship is heaving upwards, the winch pays out or 'renders' wire, holding back the load and providing a braking function. This phase generates energy rather than consuming it. When the ship is heaving downwards, the winch picks up or 'recovers' the wire which consumes energy. Recovering and storing the energy during the 'render' phase and releasing it again during the 'recovery' phase can reduce overall system power demand by up to 75%.

Q: How is this practically done?

A: Passive Heave Compensation (PHC) Systems achieve this very simply by using hydraulic cylinders and sheaves with nitrogen charged accumulators in a 'gas spring' arrangement. When the vessel heaves up the cylinder is compressed, forcing more oil into the accumulator causing the gas pressure to rise. The kinetic (braking) energy is therefore converted to stored energy in the compressed gas. When the vessel heaves down again, the stored energy in the gas forces the cylinder to extend.

With AHC, energy storage and recovery is more complex but kinetic energy can be recovered and stored in a number of ways: for hydraulic systems, in accumulators and for electric systems in capacitors, batteries or flywheels.

Q: So PHC is the answer?

A:No, not really. Drawbacks of PHC are that the accumulator gas pressure has to be set for the particular load to be lifted which is operationally inconvenient and time consuming as each time a different load is lifted, the gas pressure has to be changed. Also positional accuracy of the load is poor as there is no actual positional control. However the benefits are simplicity and that the only energy consumed is the energy required to set the initial gas pressure. During operation of the PHC, no input energy is required.

Q: So how do I achieve the accuracy of AHC but with low power consumption?

A: For pure AHC, power consumption can be dramatically reduced with kinetic energy recovery. Alternatively a PHC/AHC Hybrid arrangement can be used in which a passive stage is incorporated to hold the load and provide most of the compensation, with a parallel active stage to fine tune the positional performance. These systems achieve good positional accuracy with power reductions similar to kinetic energy recovery in purely active systems.

Q: What if my winch doesn't have enough power?

A: There are several options: replace it, upgrade it, accept limited compensation performance or install a standalone linear flying sheave compensator such as the 'Nereus' system (www.screaton.net) in the lift path. Replacing or upgrading the winch is expensive and may be impractical. If so, one option is to accept limited compensation performance and to reduce heave amplitudes to within the power capacity of the existing winch.

Adding a flying sheave linear (cylinder) compensator is a very cost effective means of adding AHC capability to a system without having to modify the winch, which sits with its holding brakes on allowing the cylinders to do all of the compensation work.

Q: So is that all there is to know about AHC?

A: Well, no. Less obvious but nonetheless serious effects such as wire fatigue is an issue and for deeper water operations; resonance, vortex induced vibration and catenary shape due to subsea currents introduce additional challenges and complexities. If you would like to find out more about X-Wave™ or Heave Compensation in general please visit www.activeheave.com or email us at xwave@activeheave.com

If you have an application that you want to discuss further please complete the specification sheet in as much detail as possible and send it to us at www.activeheave.com or via your local sales agent.

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Enquiry Specification (please answer as fully as possible)

1. Project

- ☐ Upgrade of existing non AHC system to AHC
- ☐ Replacement of existing AHC system
- ☐ New equipment

2. Scope of Supply

- ☐ AHC control system only
- ☐ Fully integrated machine control system + AHC
- ☐ Power & Drive Train (IF YES - COMPLETE BOXES BELOW)
  - ☐ Variable Speed Drives
  - ☐ Motors & Brakes
  - ☐ Gearboxes
  - ☐ Kinetic Energy Recovery System

3. Type of Compensator

- ☐ Winch
- ☐ Cylinder

4. Power

- ☐ Electric
- ☐ Hydraulic

5. Compensation Performance Required

Heave Amplitude (peak to trough)	m
Heave Period (peak to peak)	s
Load (max)	Te
Water Depth (max)	m

6. Operation Modes

- ☐ Active Heave Compensation
- ☐ Active Heave Compensation + Constant Tension
- ☐ Constant Tension
- ☐ Performance Simulation

7. Features

- ☐ Wire Fatigue Monitoring
- ☐ Auto Lowering
- ☐ Datalogging
- ☐ Remote Diagnostics

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8. Additional Information

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