IHC has a long history of delivering passive and active heave compensation systems to customers operating in the offshore, and oil and gas industries. They are now widely used around the world to ensure a load remains motionless, increasing safety and efficiency in a range of operational activities.

The technology can be categorised into two distinct types. A passive heave compensation (PHC) system acts as a shock absorber, with a hydraulic cylinder storing and releasing the energy transmitted by incoming waves. It is a standalone system and as such requires no external power, representing a lean and simple method of compensating for wave motions.

A more sophisticated solution is the active heave compensation (AHC) system, which is able to take highly accurate, real-time measurements from an external motion reference unit before compensating for any movement. AHC systems benefit from the ability to actively control any oscillations at a specific point, using active power to improve accuracy.

IHC is able to help customers define their system requirements, and offers the complete package for the delivery of advanced and efficient motion compensation systems, from engineering and analysis through to fabrication, installation, commissioning and life-cycle services.

Custom-built systems

Motion compensation technology offers a number of important benefits to companies engaged in any kind of lifting or hoisting activities. It enables operators to work for longer periods of time at high sea states, minimise downtime, and extend operational weather windows.

“I think many companies are coming to recognise the advantages of an integrated, tailor-made motion compensation system designed for a specific application,” says Arjan Jansen, Senior Sales Manager Motion Control and Automation. “For example, we are seeing an increase in subsea activities, and more traditionally surface-based projects are being relocated subsea. As a result, offshore inspection, repair and maintenance work is starting to increase.”

Interest in motion compensation systems in general has also seen an increase. This is in part due to the far-reaching applications of the technology that extend beyond traditional lifting and loading operations, many of which are a response to growing safety concerns in the offshore industry.

“Many of the companies developing motion compensated gangways have had a lot of success recently,” explains Bas Kockmann, Account Manager Winches. “This is very interesting from our point of view, because the industry is becoming more aware of the possibilities. Where else can we apply this kind of technology?”

A project completed for Shell demonstrates this. Arjan explains: “It involved a jack-up platform with an onboard crane, for use in offshore applications. A foundation monopile was required to be lifted from a moving vessel, and so we deployed an offshore load tensioning system.

“The system transferred the load from the vessel onto the crane in three steps, with a motion compensator positioned in between the hook and the crane’s load. An additional boost function avoided the load colliding with the vessel, and the installation was a complete success.”

Operating in dynamic sea states often results in uncontrolled motion of the payload – which in turn leads to slack wires and large snap loads. Royal IHC’s motion compensation systems help to mitigate these risks, enabling customers to work safely and more efficiently. They can also be customised to meet any number of requirements or challenging operations.
In the field

Further examples of IHC’s activities in the field can be found in the delivery of AHC systems for a range of dredging vessels for Van Oord, the latest in this line being the VOX MAXIMA, and the EPC (engineering, procurement and construction) delivery of a system for the YANTAI 5000, a heavy-lifting/pipelaying vessel constructed for the Yantai Salvage Bureau by Shanghai Zhenhua Heavy Industries Co., Ltd. (ZPMC) in China.

Designed for the installation of 400t loads at water depths of up to 3,000m with minimal energy consumption, the system for ZPMC allows the vessel to perform more installation jobs each year, maximising returns on the asset investment.

The integrated delivery consisted of an extensive range of equipment, including a storage winch for 3,500m of wire rope, the complete drive and control system with motion reference unit, and controls cabin.

Because instant wire load changes occur when entering the splash zone, IHC’s AHC system keeps the hoisting wire tensioned and minimises uncontrolled motion. Meanwhile, typical frequencies are neutralised in order to avoid resonance without unwanted side effects, and a stepless and controlled descent ensures a safe landing.

Another notable project was the delivery of a module handling system on the MSV SEAWELL for Helix Well Ops UK, a vessel dedicated to the intervention of subsea wells in the North Sea area. The system features an inline heave compensator for the main hoist and several AHC winches combined with PHC tensioners. In addition, it is equipped with a cursor system with two constantly-tensioned cursors to guide the payload through the splash zone.

Functionality and safety

The AHC systems supplied for both of these projects were designed with an integrated spring-loaded hydraulic cylinder, which makes the system partly passive itself.

Most of the load is absorbed by the spring, but a separate active system runs in parallel to actually control the cylinder and maintain its exact position while compensating for motion.

The result of this is that only a small amount of energy is required to make the system work. “For example, the system we produced for ZPMC required around 2.4 megawatts of electricity,” explains Bert Knol, Hydraulic specialist. “Without the integrated passive spring in the cylinder, it would have required four times this amount.”

“In terms of functionality and safety on the MSV SEAWELL Module handling system, we included PHC as a backup measure in the event of an AHC system failure,” says Jurgen Zijlmans, Lead Engineer Integrated Mission Equipment.
New opportunities

IHC’s strength lies in its ability to provide solutions for a wide range of different scenarios, and is able to advise its customers when to use PHC, AHC, or a combination of the two. Through its integrated approach and extensive knowledge base, it is able to supply complete motion compensation systems that enable customers to work safely and more efficiently, as well as maximise a vessel’s operational timeframe.

“The offshore wind market is growing,” says Arjan, “not only in The Netherlands and Germany, but also in the UK and the US. We’re also seeing a rise in floating wind turbines in southern Europe and Japan – we’re working on a few of these large projects already.

“What we are starting to note on a regular basis is that our customers need high-quality motion compensation equipment on their assets in order to be compliant for participating in specific tenders for projects. It might not be used regularly, but that feature gives them an advantage over the competition. In addition, IHC is able to provide training services to ensure operators can receive the skills required to use the equipment safely.”

Jurgen adds: “We are also starting to integrate these systems with existing vessels, as work is moving deeper underwater but operators don’t have the dedicated equipment required to work safely and efficiently. My feeling is that we will start to see a need for modular systems that will be used for specific tasks or problems, which can then be removed once work is complete.”

Rental fleet

Due to the success of a number of projects using IHC’s integrated motion compensation equipment, there was a demand from the market for an increased range of options. In response to this, IHC developed the MaXine PHC, which can be used for single lift operations, and can handle dynamic loads varying from 50-500mT.

“We have developed a range of standard, catalogue products,” says Marc Beldman, Managing Director IHC Vremac Cylinders. “These models are ideal for use as part of a rental fleet, so if an operator needs to carry out hoisting work and the weather window is condensed, or there is a need for increased safety measures, he can choose to rent a system quickly.”

The range is available for worldwide use and the equipment does not require the installation of any special lifting frames.

Research and development

In order to estimate the total overall performance capability of a system before it is actually manufactured, dynamic models are used for simulation and evaluation purposes for different offshore scenarios.

“One of the problems we observe at great depths is the oscillation of the hoisting wire,” says Jacco Osnabrugge, Manager R&D Motion Control and Automation. “Under normal circumstances, motion would only be compensated at the hoisting point, but despite that we still see payload oscillations of several metres at depths of 3,000m. You must also compensate for the dynamics of the entire cable system, and we strive to understand that behaviour and remove the oscillations by developing advanced compensation controllers.”

There is also potential for applications such as drilling and riser-tensioning. “We are seeing new ideas being generated with the aim of reducing costs in the offshore industry,” continues Jurgen. “There’s an increase in requirements for custom-made tensioning systems, for example vertical top-tensioned riser tensioners for drilling and production risers but also lateral retention systems for drill risers.

“When large structures are being towed from their production location to a specific site, safety and security is of the highest importance; if a rope breaks then this could cause damage to the tugboat or, in the worst case, harm to a person. We’re working on a system that can be installed on existing vessels to help solve this problem using motion compensation technology.”

Another avenue is in large crane vessels used for the installation of foundations for wind turbines. Normally, the vessel is anchored, but this can have large time and cost implications. “We looked at the use of spud poles to ‘anchor’ and stabilise the vessel in a very fast and safe way,” says Jurgen. “This involved the use of a motion compensation system. The result is a floating vessel but with very limited motion. We are also evaluating the potential for using fibre rope on high loads for deep-sea lowering applications, although this is still in the early feasibility stage.”