POSCOM

Spread Spectrum Combined Acoustic Positioning and Communications

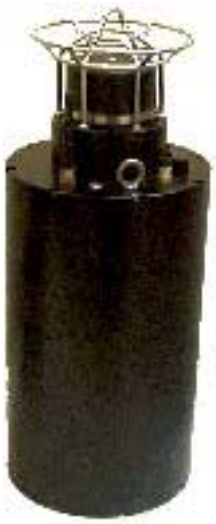
POSCOM Summary

POSCOM is a spread spectrum underwater positioning system developed under the SeaSense program in collaboration with Subsea 7, Chelsea Technologies Group, QinetiQ and the University of Newcastle. A series of trials have been conducted to demonstrate the noise and reliability performance of the POSCOM system in acoustically hostile environments.

A typical application located two POSCOM beacons on the seabed in proximity of a pipeline bundle tow out, conducted by Subsea 7 tugs. A receiver system was located on a trials vessel that recorded all acoustic signals throughout the trial. Tug spectral noise density was comparable to standard values derived from a similar class of tug whilst spreading losses within the bay approximate to a 20log r spherical spreading model.

Applying this data to that gathered during this trial, POSCOM operated successfully in environments displaying signal to noise ratios of between –11dB and –15dB. This compares favourably with predicted theoretical performance. Furthermore, once tracking POSCOM could operate at even higher levels of background noise.

POSCOM exhibited reliability and repeatability of ranging that would not be achieved by a standard continuous wave positioning system. Indeed, with an already proven range accuracy of better than 5cm rms and an 8km range capability in shallow water with an equivalent source level of 157dB re 1μPa @1m in a 6kHz band, POSCOM can meet the demands of providing an accurate positioning system even in acoustically hostile environments.



POSCOM Technical Advantage

In terms of noise performance, a pulsed Narrow Band continuous wave (CW) system achieves processing gain by filtering the input signal around the transmission bandwidth. To maximise processing gain, one uses a Narrow Band filter, since this rejects more noise. However this conflicts with the need for the system to have good range resolution. Range resolution is ultimately determined by the transmission bandwidth and so in a conventional Narrow Band CW system the pulses must be short and the receiver bandwidth large to achieve good range resolution. Increasing the receiver bandwidth admits more noise and this in turn reduces the noise performance of the system. The processing gain afforded by a pulsed Narrow Band CW system is unity. Narrow Band CW pulses are subject also to fading in multipath environments that can degrade performance.

POSCOM Beacon

POSCOM implements pulse compression that overcomes these limitations and provides processing gain determined by the bandwidth time (BT) product of the transmission pulse. In such systems the processed signal to noise ratio is improved by a factor of between BT to 2BT depending on the precise implementation of the receiver processing. POSCOM realises a processing gain in the region of 27dB and operates with a detection threshold between –9dB to –15dB depending on environment. The advantage of using digital waveforms over conventional swept sinusoids such as chirps stems from the ability to exploit a wider signal set whose correlation properties are superior to those of chirps, provided they are processed appropriately. This inherently gives the system a data transmission capability plus superior range and Doppler tracking performance.

POSCOM Wick Trial

The POSCOM trial was undertaken during a pipeline bundle launch at the Subsea 7 facility in Wick. The trial was conceived to illustrate the performance of the POSCOM system in an acoustically hostile environment where conventional baseline transponders fail to operate. The Subsea 7 pipeline bundle tow out provided the high acoustic noise environment required. The geometry of the trial placed two transmitting beacons near to the pipeline bundle tow out path. The receiver was situated between the two beacons and recorded ranges to the beacons as the trials vessel drifted. As the tugs began the pipeline tow out the POSCOM receiver system recorded ranges, this continued as the tugs passed the receiver and both subsea beacons.

The POSCOM system demonstrated successful operation with signals -15dB below the noise floor. This figure is comparable with the predicted theoretical performance that states operation between –9dB and –15dB, dependent upon the acoustic environment. The POSCOM system also showed tolerance to higher noise levels during tracking. In comparison to standard Narrow Band CW acoustic positioning systems this performance is exceptional, as such systems require a reasonably high signal margin above the noise floor to operate successfully and will not tolerate multipath conditions.

POSCOM also demonstrated a reliability and repeatability of operation that certainly is not matched by standard acoustic positioning systems, particularly in such hostile acoustic environments with received signals –15dB below the noise floor.

POSCOM Capabilities

POSCOM has undertaken several trials during the development program. These include the Wick noise trial, reservoir trials to access range accuracy and a shakedown sea trial in Weymouth Bay. These trials have demonstrated the following capabilities of the POSCOM system.

- Ability to operate with received acoustic signals approximately –15dB below the noise floor. A significant performance advantage over standard Narrow Band CW positioning systems.
- Ability to tolerate higher background noise levels once the system is tracking.
- Reliability and repeatability of ranging in acoustically hostile environment. This performance would not be matched by a standard Narrow Band CW positioning system.
- Proven range accuracy better than 5cm rms.
- Range capability of 8km in shallow water with very low equivalent source level of 157dB re 1µPa @1m in a 6kHz band.

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