

Fuel efficiency of fishing vessels:

The influence of roll stabilisation

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How roll motion reduces fuel efficiency and safety

- Roll-pitch and roll-yaw coupling means increased resistance when rolling
- Roll damping mechanisms (paravanes, fins etc.) add hydrodynamic drag
- Roll motion generates non-uniform inflow to prop, reducing propulsive efficiency.
- Sea sickness and lateral motion reduces crew efficiency

Roll reduction options (retro-fit)

- Bilge keels
- Paravanes
- Active fins
- Sea Gyro

Disadvantages of hydrodynamic systems

- Can be sensitive to wave direction and speed
- Active fins are ineffective at low speeds
- Increase drag by vanes, fins or keels
- Extra weight increase drag
- Subject to damage by sea debris

Sea Gyro

Advantages:

- Effective at all vessel speeds
- No hydrodynamic drag
- No risk of damage by sea debris
- Small and easy to use – set and forget
- Energy efficient when running
- Safe in shallow water

Disadvantages:

- Slightly heavier than bilge keels or paravanes
- More expensive than bilge keels or paravanes

Gyroscopic motion reduction

Model loaded for comparative effects on a 20 metre boat
in seas of 1.5 metres



Roll without gyroscope



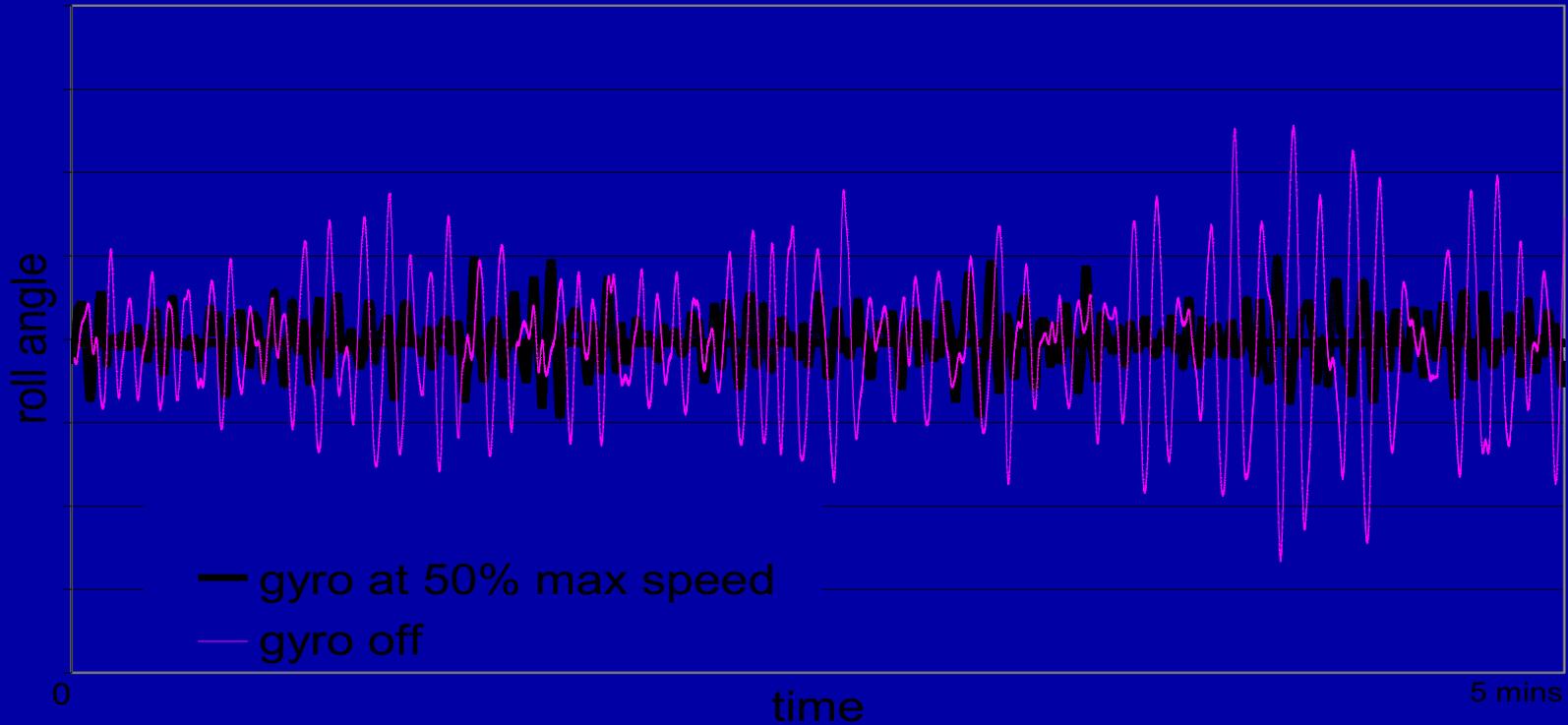
Roll with gyroscope

Prototype development



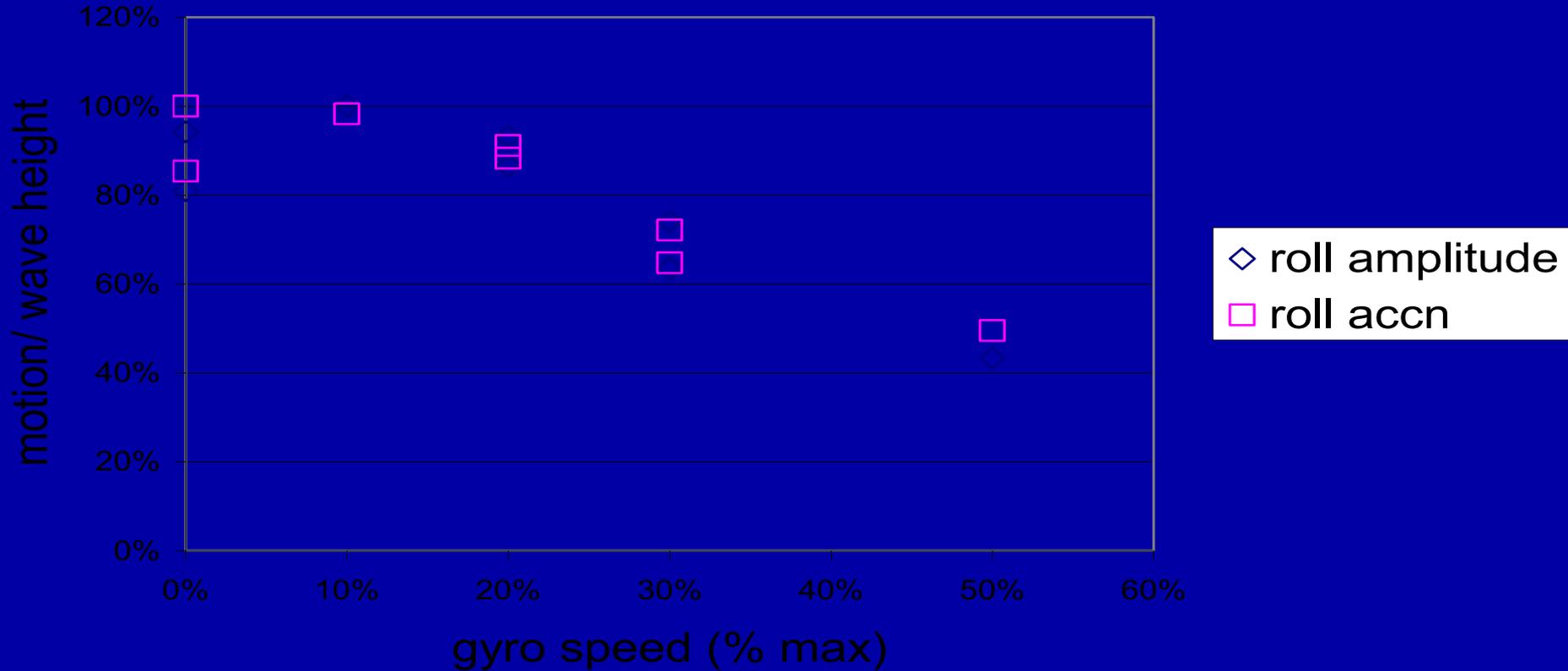
Two Sea Gyro prototypes on aft deck on 14m trials vessel

Full scale trials results



50% roll reduction with Sea Gyros operating at only half speed

Full scale trials



Roll reduction with increasing gyroscopic speed

Possible research paths (i): paravanes & fixed fins

- Numerical optimisation of configuration at UNSW and Curtin
- Model experiment validation at AMC
- Full scale trials – vessel of opportunity
- Outcomes: Reduced hydrodynamic drag
~20%?

Possible research paths (ii): Sea Gyro

- Quantify drag reduction from coupled motions: Model experiments at AMC
- Full scale trials – vessel of opportunity
- Outcomes: eliminate stabiliser drag (20% of total calm water drag) + reduce added resistance in waves ~10 - 20%?

Models



o The new mini Sea Gyro

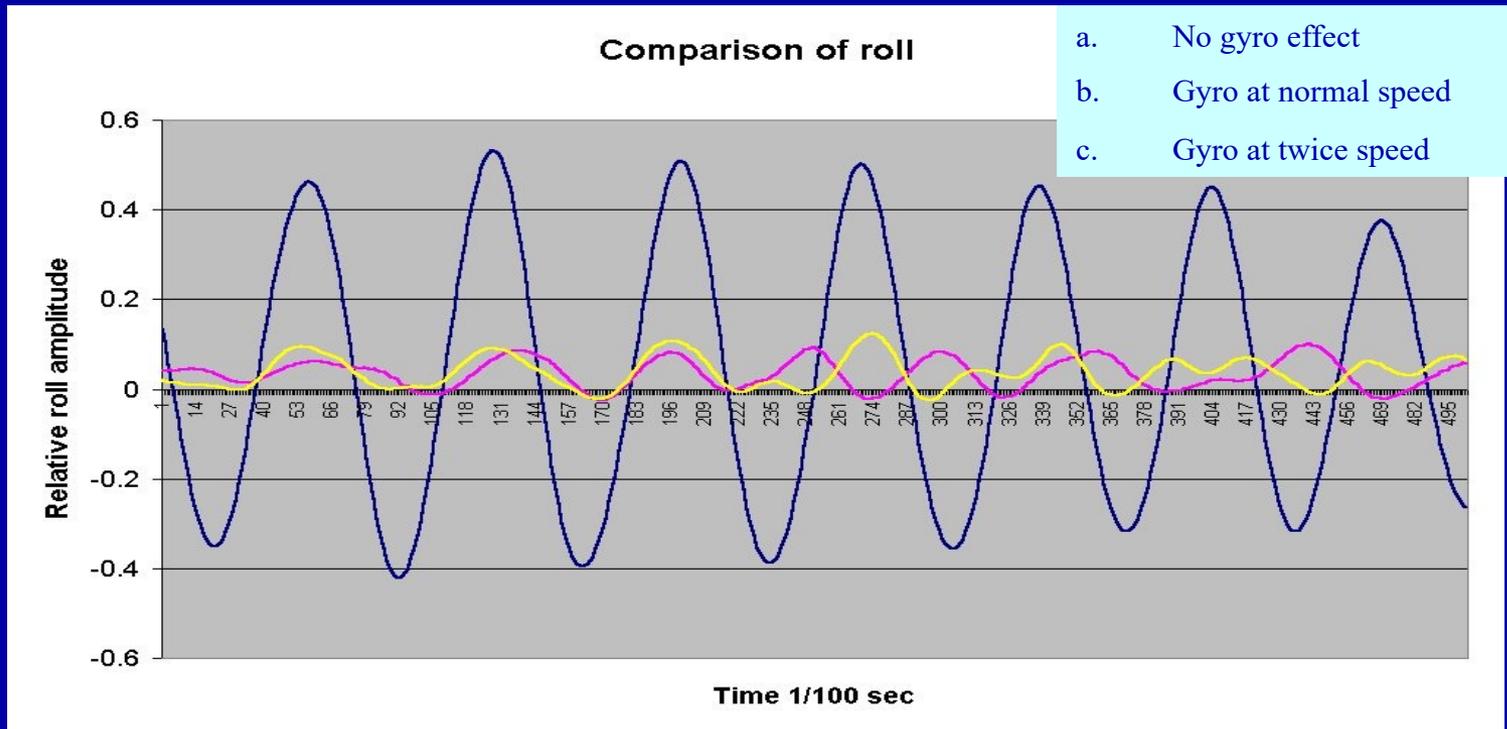
- o One of two units installed on a charter vessel

Large forces may be applied through forced precession



Driving the gyroscope through small angles can roll the vessel in calm water

Preliminary numerical modelling



- Roll is reduced by 80% of the extreme value by use of the gyroscope