


# Navatek Aft Lifting Body (ALB)

A black inflatable boat with a raised cabin structure is moving across the water at high speed, creating a large white wake. The boat is viewed from a side-rear perspective. In the background, there are mountains and a coastline under a clear sky.

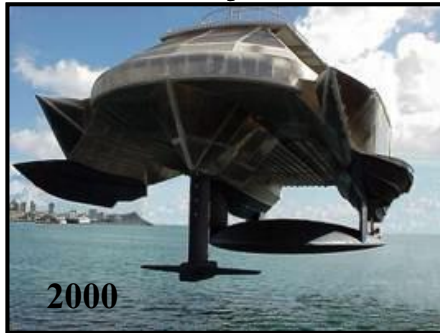
Reducing Slams on High Speed Craft  
High Speed Boat Operators Forum  
Gottenburg, Sweden  
April 17<sup>th</sup>-19<sup>th</sup>, 2012

# Adaptive Ride Enhancement System (ARES) / Aft Lifting Body (ALB)



Products of earlier research

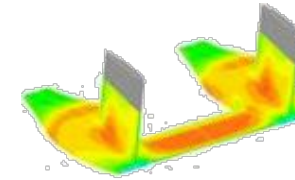
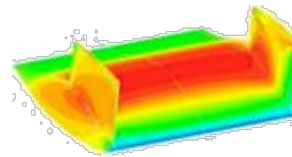
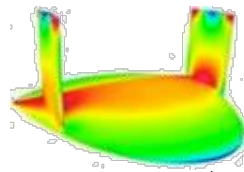
*Midfoil*



*Sea Flyer*

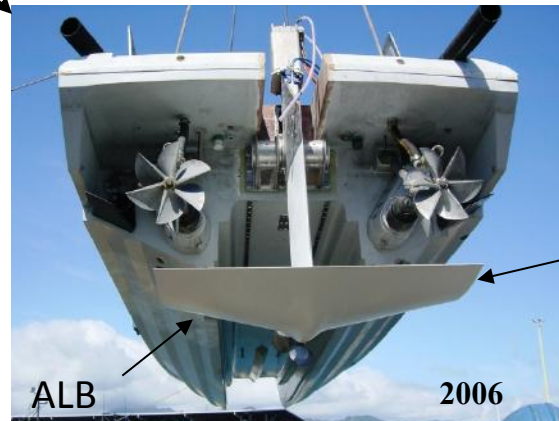


*HDV-100*



Increase payload and mission effectiveness

- Retractable to preserve shallow water capability and transportability
- Increased efficiency through hump speeds



ALB dramatically reduces slams and motions

- Large plan area provides effective motion damping from rest to 40+ knots
- Improves directional stability and controllability
- Passively stabilizes roll

Proven on all types of high speed craft, works with all propulsion systems

Three more projects nearing the trials phase



11m LCS USV

11m NSW RIB

SeaBlade 40'



Phase II SBIR complete

Rough water trials complete

Available for trials

# NSW/ALB Side-by-side Testing following seas, 30-34 knots



Note: ALB boat 1700 lbs heavier



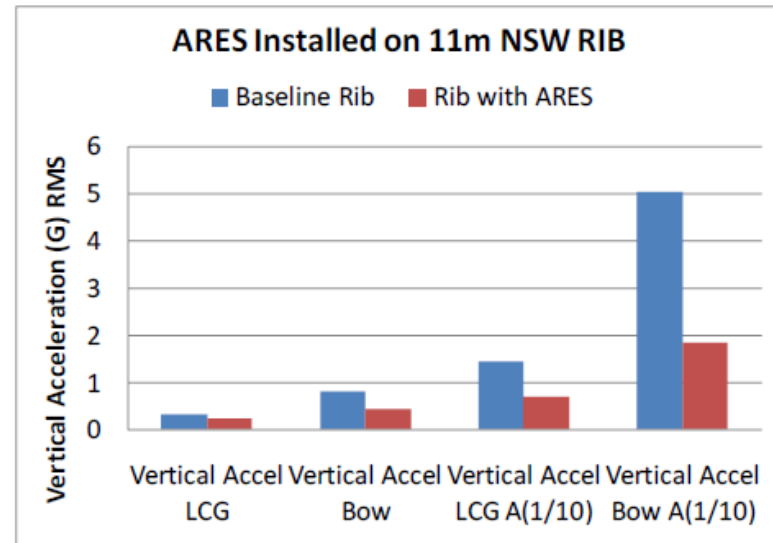
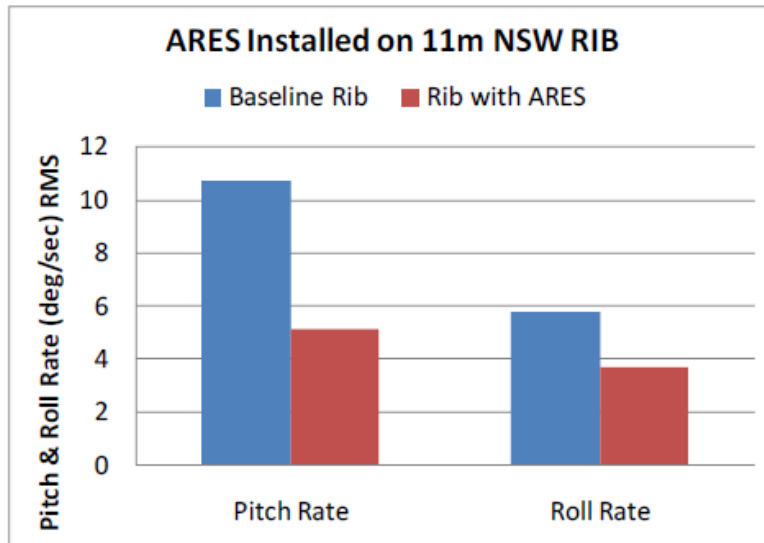
ALB

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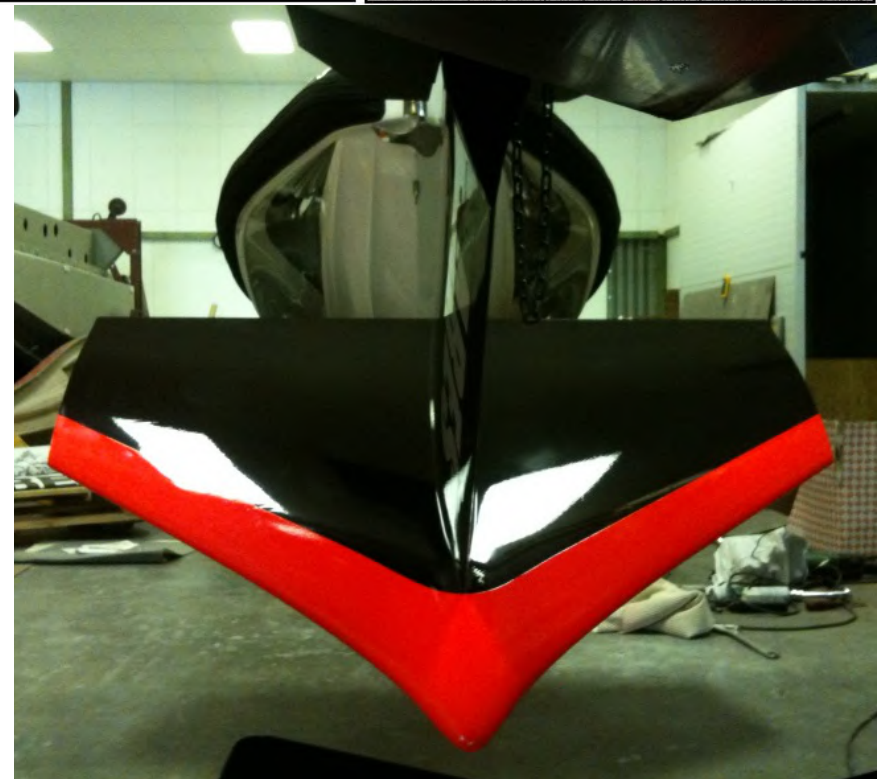
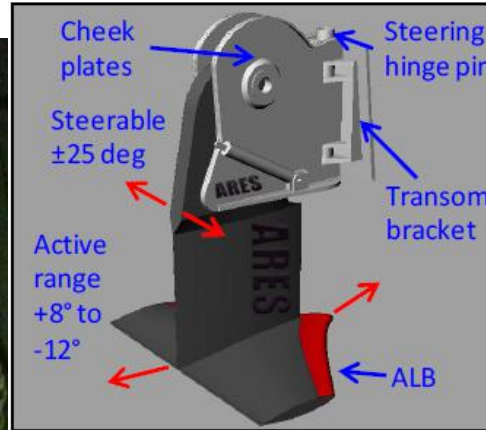
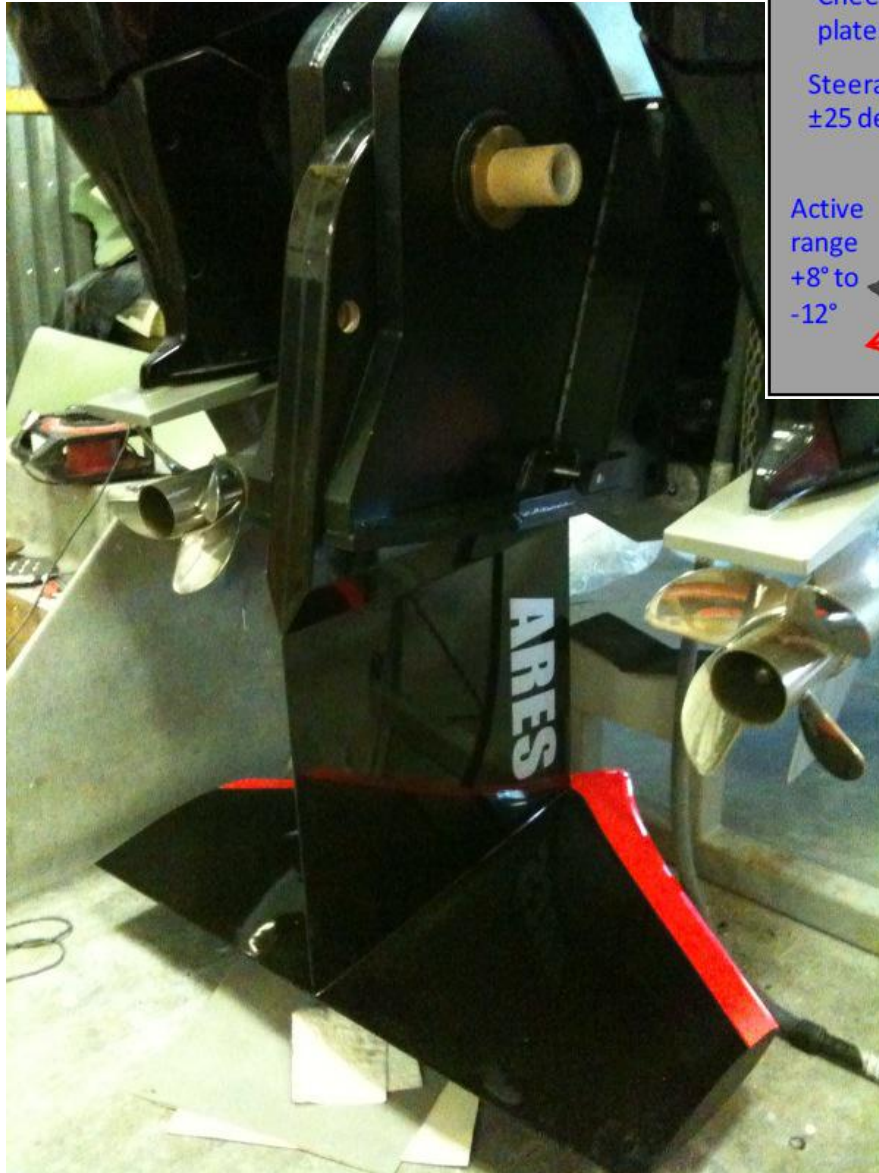
# Large reductions in motions in side-by-side testing

	Baseline RIB	RIB with ARES	% reduction
Pitch Rate	10.7 deg/sec RMS	5.1 deg/sec RMS	52%
Roll Rate	5.8 deg/sec RMS	3.7 deg/sec RMS	36%
Vertical Accel LCG	0.32 g RMS	0.23 g RMS	28%
Vertical Accel Bow	0.82 g RMS	0.43 g RMS	48%
Vertical Accel LCG A(1/10)	1.45 g RMS	0.71 g RMS	51%
Vertical Accel Bow A(1/10)	5.05 g RMS	1.84 g RMS	64%



## Cruise Speed, Sea State 3, Head Seas Results

# ALB on Sea Blade



# Head Seas Cases

## Active ALB

7 minutes of data, head seas 2-4'  
 Speed 36.6 kts avg / 0.6 kts RMS  
 Track 260 deg avg / 2.5 deg RMS  
 Pitch 3.02 deg avg / 0.50 deg RMS  
 Roll -.26 deg avg / 1.19 deg RMS  
 Pitch Rate 4.08 deg/s RMS  
 Roll Rate 4.31 deg/s RMS  
 Yaw Rate 0.77 deg/s RMS

	RMS (g)	A <sup>1/10</sup>	Aw(8)	MTVV	VDV
Surge	.046	.112	.355	1.52	2.20
Sway	.060	.220	.384	1.88	2.53
Heave	.408	1.44	2.39	12.04	16.89
Time to EAV	21 min				
Time to ELV	1hr 51 min				
SED(8)	2.173 Mpa, 701 impacts				

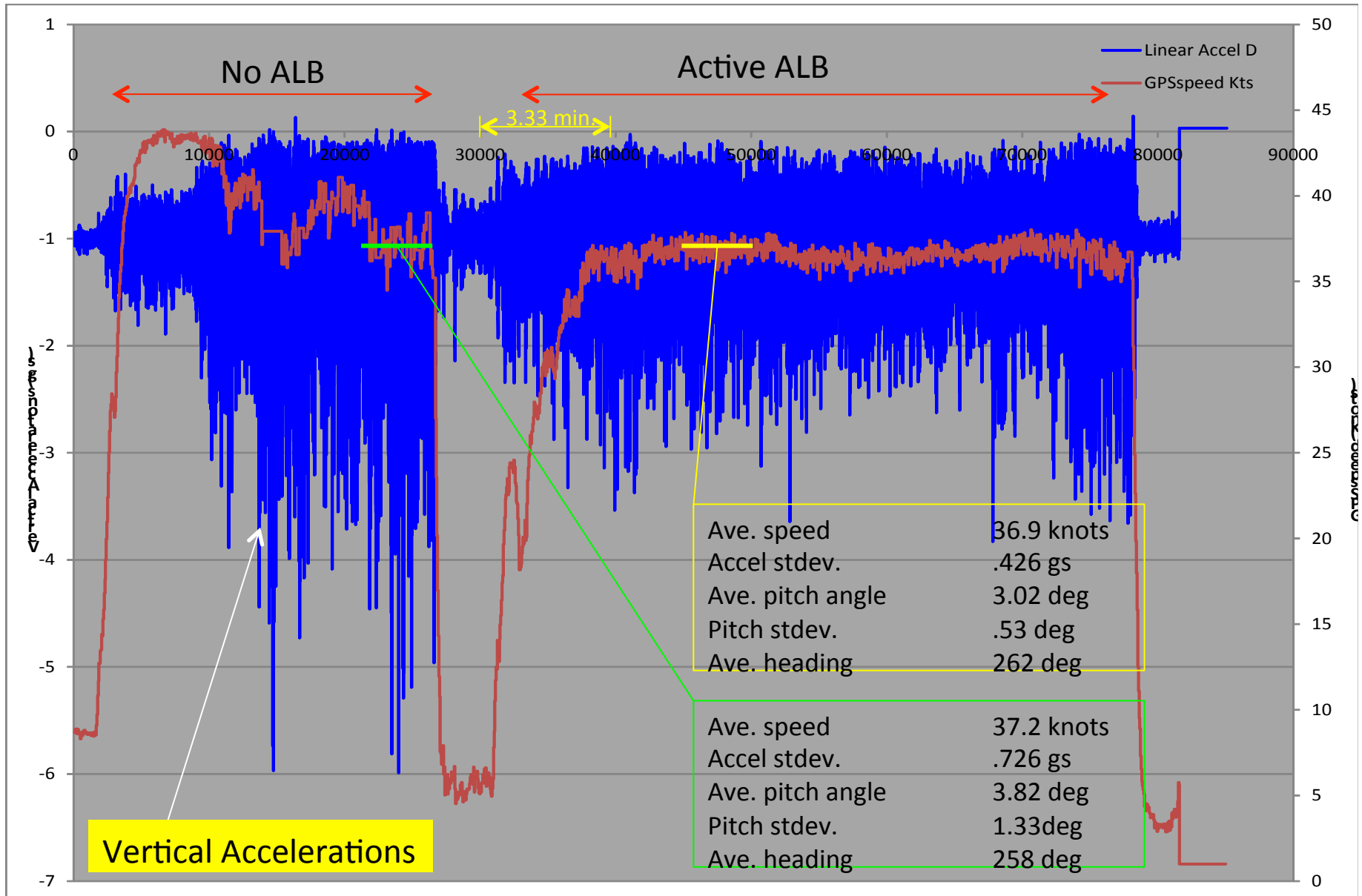
## Retracted ALB

3 minutes of data, head seas 2-4'  
 Speed 38.2 kts avg / 1.5 kts RMS  
 Track 250 deg avg / 8.0 deg RMS  
 Pitch 3.65 deg avg / 1.27 deg RMS  
 Roll -.24 deg avg / 1.17 deg RMS  
 Pitch Rate 7.25 deg/s RMS  
 Roll Rate 4.55 deg/s RMS  
 Yaw Rate 1.35 deg/s RMS

	RMS (g)	A <sup>1/10</sup>	Aw(8)	MTVV	VDV
Surge	.079	.204	.63	1.948	3.219
Sway	.075	.428	.476	2.62	2.974
Heave	.649	2.67	3.802	20.06	26.01
Time to EAV	8 min				
Time to ELV	0hr 44 min				
SED(8)	4.505Mpa, 303 impacts				

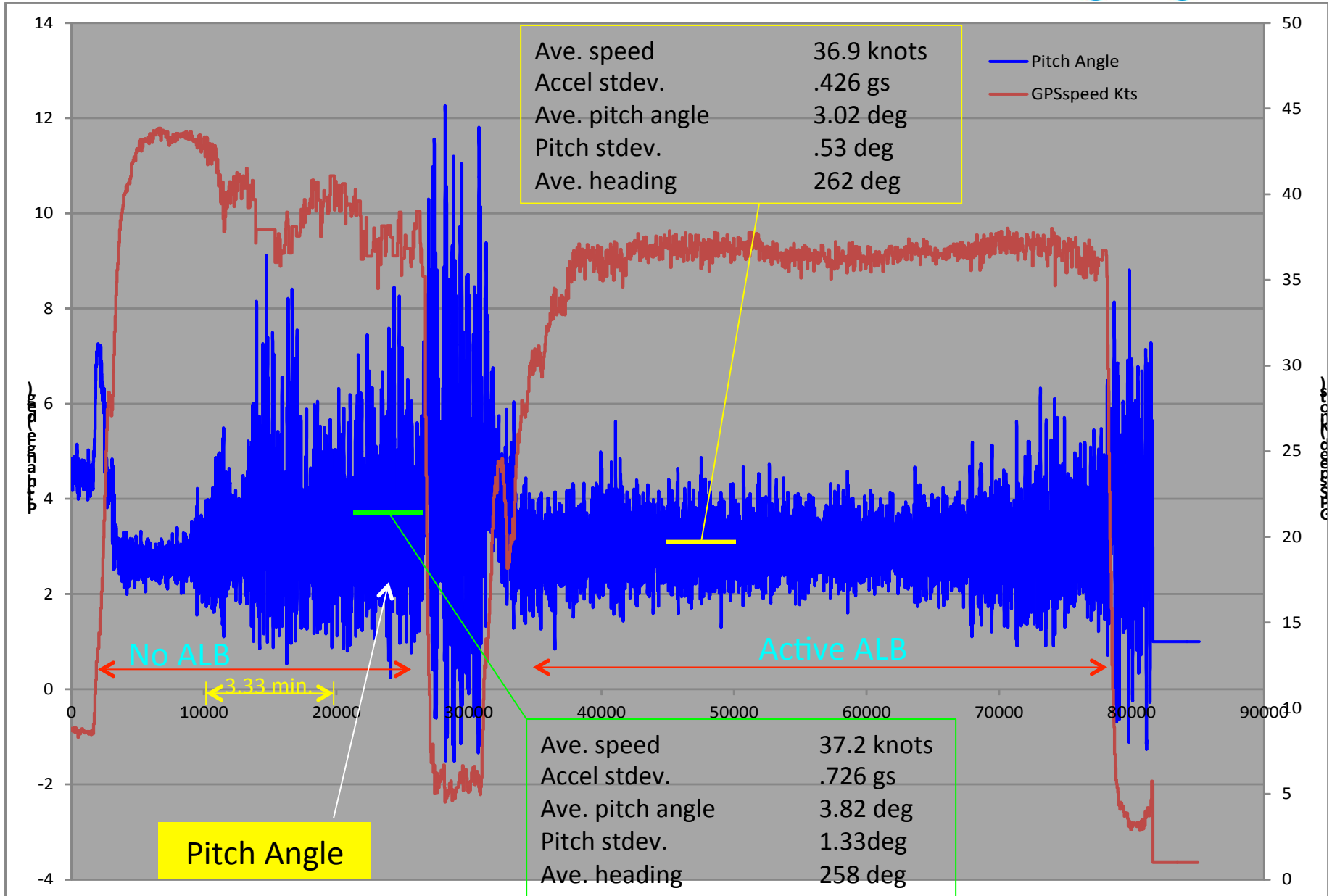


# 41% reduction in heave accel RMS

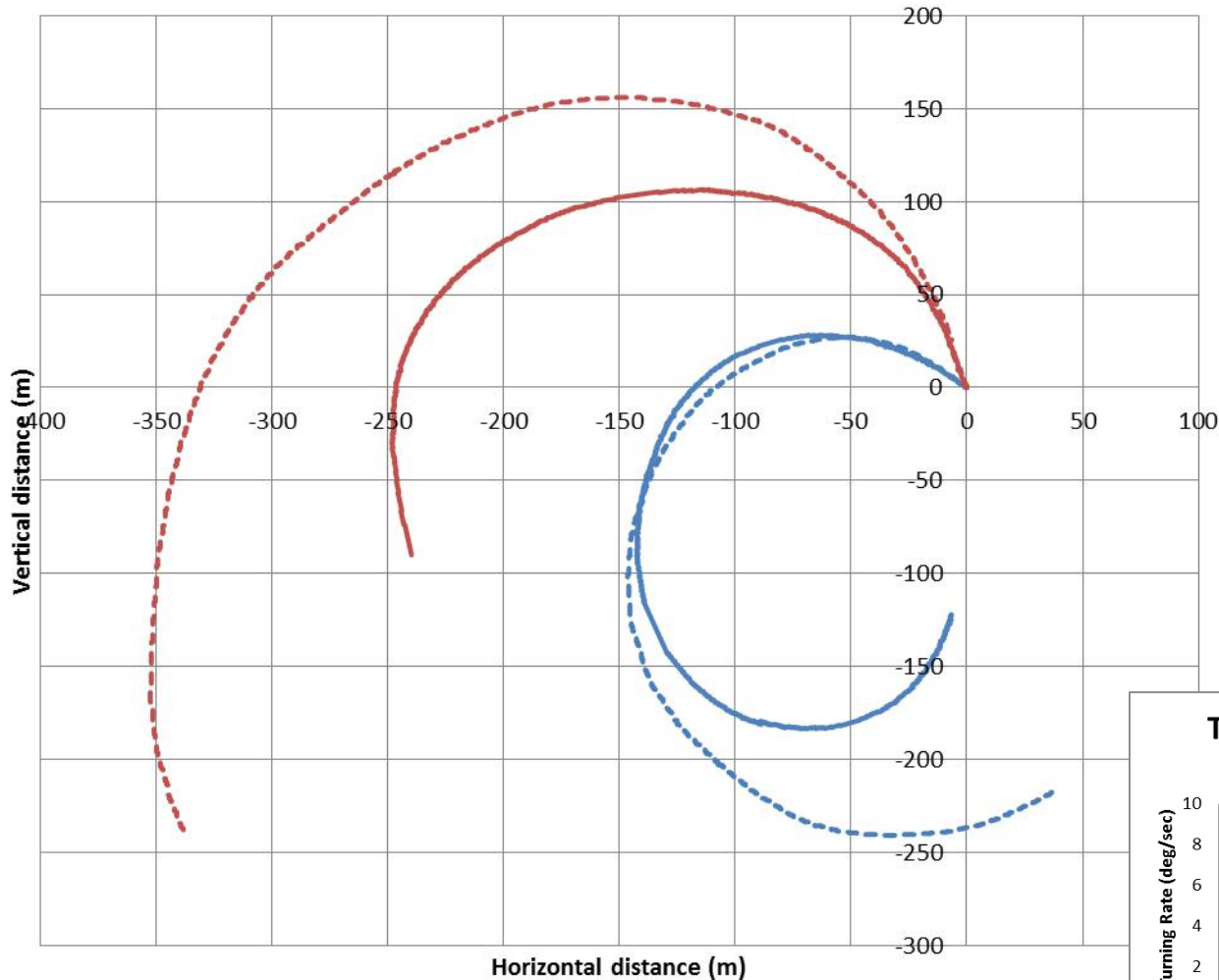




# 60% reduction in Pitch RMS



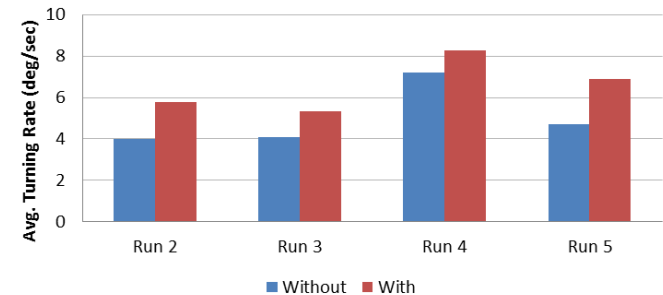
## Turning Radius improvement with ALB, Seablade in 2-3 foot chop



Average  
34% improvement

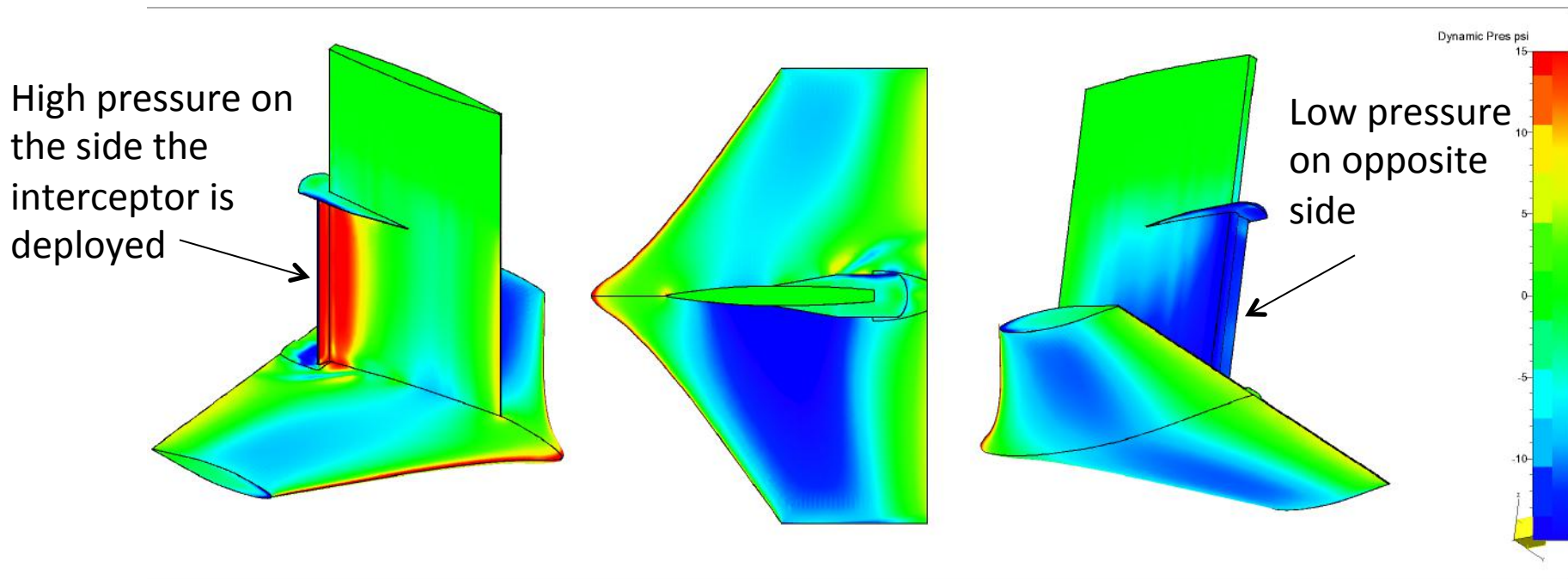
- #4 (no ALB)
- #4 (with ALB)
- #5 (no ALB)
- #5 (with ALB)

### Turning Rate Improvement from ALB, Seablade in 2-3 foot chop

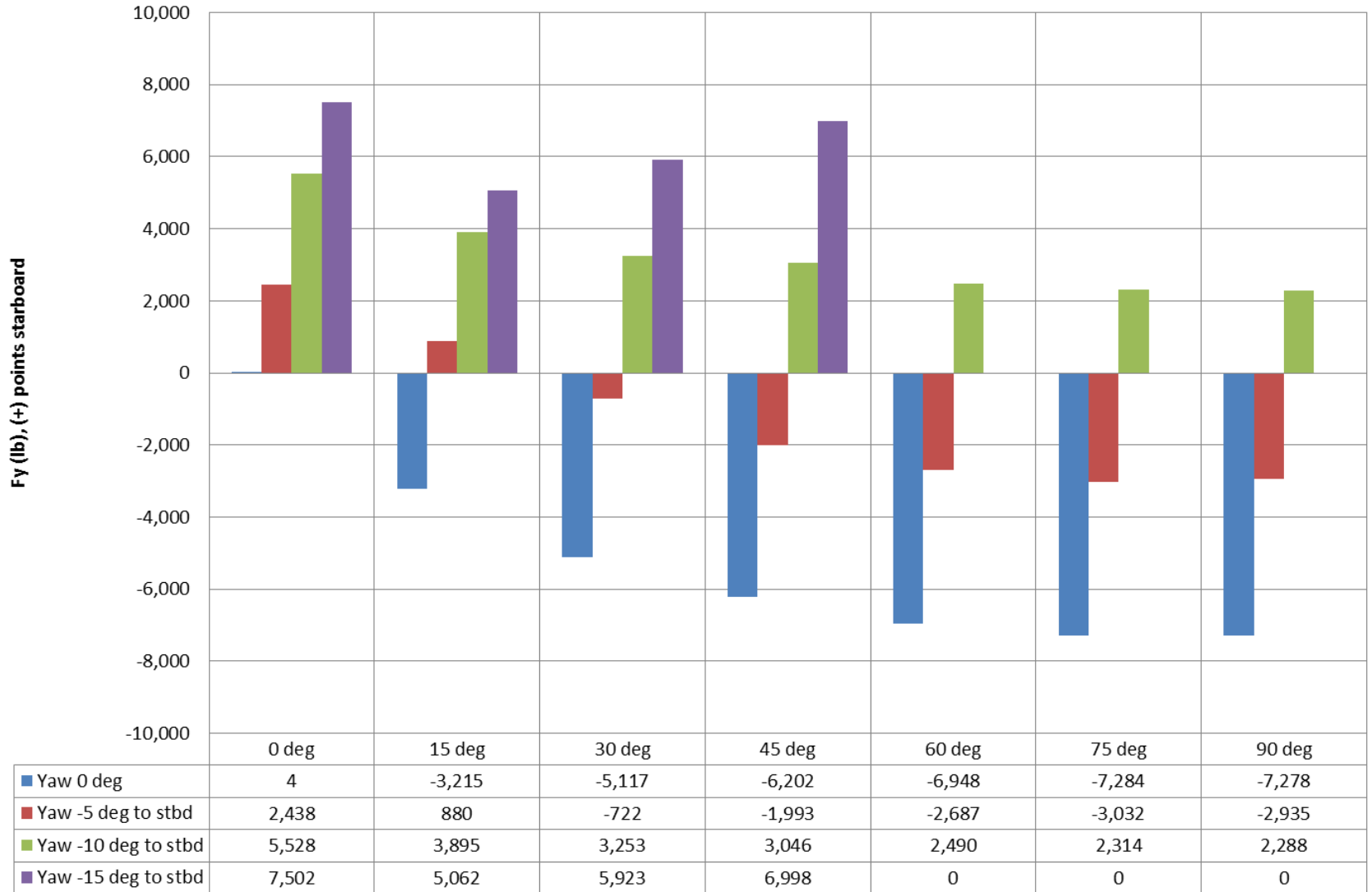


## ***Turning Performance:***

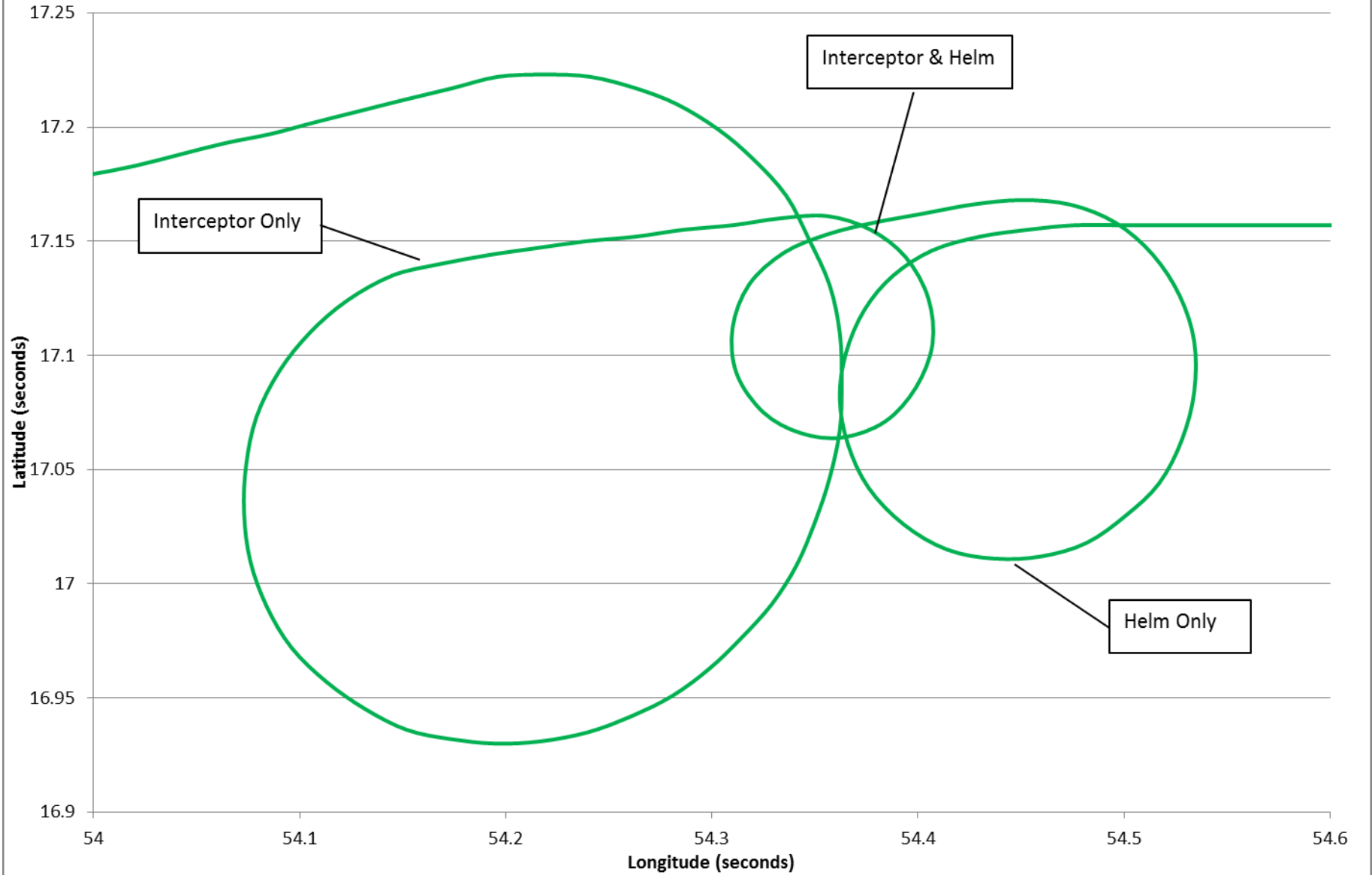
To maintain the turning performance of the NSW 11m an interceptor steering mechanism is proposed for the trailing edge of the strut. An interceptor uses stagnation pressure on the strut to generate side forces for turning. The interceptor would be coordinated with the waterjet steering system and deploy to either side of the strut depending on the direction of the turn. The below images show the pressure distribution from a design study.



## FINE/Marine Study of NSW-RIB ALB @ 40 kt, 0 deg AOA, fixed Fy (lb) vs Int Tab Angle (deg, deflected starboard)

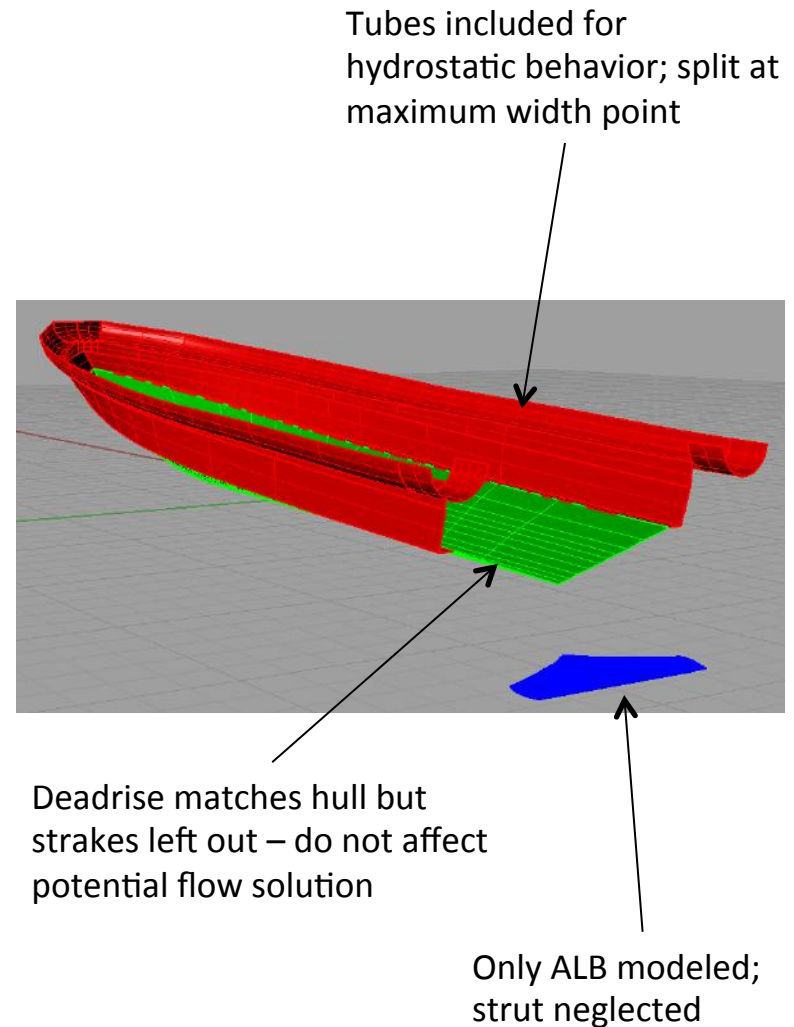


## 25 knot Turning Circles ALB steering Interceptor - Aronow CAT



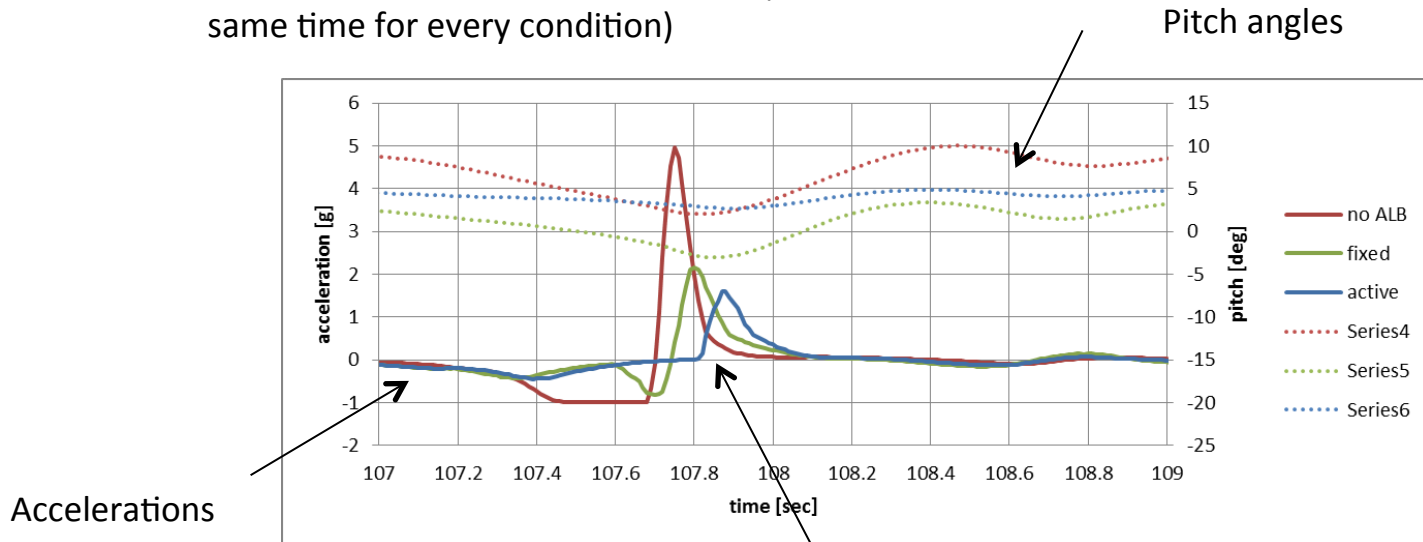
# Simulation

- Boat modeled using Rhinoceros
- Strut neglected
  - Simulation only 2DOF (heave and pitch) so strut will not affect solution
- Tubes included – assume to separate at maximum beam
  - Included only as hydrostatic and Froude-Krylov surfaces
- Aegir panel code for simulation with hooks for control system inputs and other force models.



# Individual Slam Event

Worst slam event from seastate run (occurred at same time for every condition)



ALB delays slam event by keeping nose down and preventing freefall

- ALB has the ability to improve a wide range of platforms

11m Sled



BR-51



NSW RIB



Original ALB demonstrator  
Aronow 40'



Sea Blade 40

- For More Information:

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