





#### Dynamic Propeller Shaft Speed Control Project presentation



MARITIME FOND







### Blue INNOship: Project2

## **Outline of presentation**

Background – the patented product idea

Validating physical mechanisms of inflow – new knowledge

**Dynamic Propeller Control – DPC - implementation** 

Installation and tests onboard – DPC at the 7 seas

Results from sea tests on Maersk Clementine

Way ahead

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Propeller Control ApS

#### 1. Analysis of DMI 1986 free sailing model tests – regular waves



#### Wake skew from DMI 1986 model tests





#### Model tests show $w'_v \sim [0.9-1.0]$



**Propeller Control ApS** 

## Propelco

#### 3. Estimate wake skew-y from Luna Full Scale



Here: v<sub>p</sub> from yaw rate only = r x<sub>p</sub>

Full Scale tests (some hours of experiments) gave conclusive results:  $W'_{yr} \approx [2.0-2.1]$  from yaw rate only. We estimate  $W'_{y} \approx [1.0 - 1.2]$  for  $v_{p} = v + x_{p}r$ 





Source: Belibassaki, Gerostathis, Politis: Calculation of ship hydrodynamic propulsion in rough seas by nonlinear BEM with application to reduction of energy losses in waves. OMAE'2013, June 2013, Nantes, France.

### **DTU-M: Nominal Wake from CFD computations**

Straight ahead





## Propeller efficiency loss due to wave and hull caused wake variations



Advance number J



Fig. 8 Axial velocity contour and velocity vector on the propeller plane

Inflow fluctuation is a mixture of contributions from hull and wave orbital motions, and seas are irregular. We therefore proceed with Marsden data for sea statistics











Marsden data for area 15, p(hs,Tz) distribution, sea from North West

Probability [%]



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### Average losses in area 15







Determine expected magnitude of losses in Marsden area 15 (North Atlantic)

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**Propeller Control ApS** 

## **Test and development setup**



#### Hardware in the loop test





Wärtsilä Lyngsø Marine A/S





### **DPC overview**





## **DPC features to protect engine**



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## Shanghai-Prince Rupert - Sea Test



## **DPC on-board**



Connecting to the EGS

Mounting the DPC





### **Setup on Clementine**



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## Long term testing on board



- Chief Engineer continued testing after we left.
- Software update was made over Summer 2016.
- Sea test 2 Suez-Newark Sep-Oct 2016.
- Continued testing Oct 2016 ongoing.

During the test, DPC will switch between DPC compensation active and not active every 60 min



## **Mimic – DPC Eco-Mode**





### Mimic – DPC Eco-Mode



#### Eco mode control authority is limited by a +/- RPM range to EGS









DPC Power-Mode one hour intervals with DPC, EGS





Compensation range ± 2 RPM increased to ± 5 RPM from mid Feb

All received data : 1.33 % saving

Weather censored (19-26 Feb - weather compensation not possible) 3.0 % saving.

DPC-e/EGS-p in 0.33 % in 1.7 m sea with ± 2 RPM band

DPC-p/EGS-p in 0.46 % in 0.9 m sea with  $\pm$  5 RPM band 27





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Compensation range ± 2 RPM increased to ± 5 RPM from mid Feb

MARITIME TECHNOLOGY

All received data : 1.33 % saving

MAERSK

Weather censored (weather compensation not possible) 3.0 % saving.

DPC-e/EGS-p in 0.33 % in 1.7 m sea with ± 2 RPM band

DPC-p/EGS-p in 0.46 % in 0.9 m sea with ± 5 RPM band

## **Constant Power Mode**



Mail from Clementine: On the way from Freeport to Suez we had the power mode on permanent and it worked perfectly. One continuous power for 14 days and we arrived as scheduled, just as we like to sail.



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All received data : 1.33 % saving

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## Commercial

### Numbers for Clementine

1% = 82500 USD / year

Maersk wish to continue Clementine tests with alternating pattern and decide the way ahead from the further results



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