



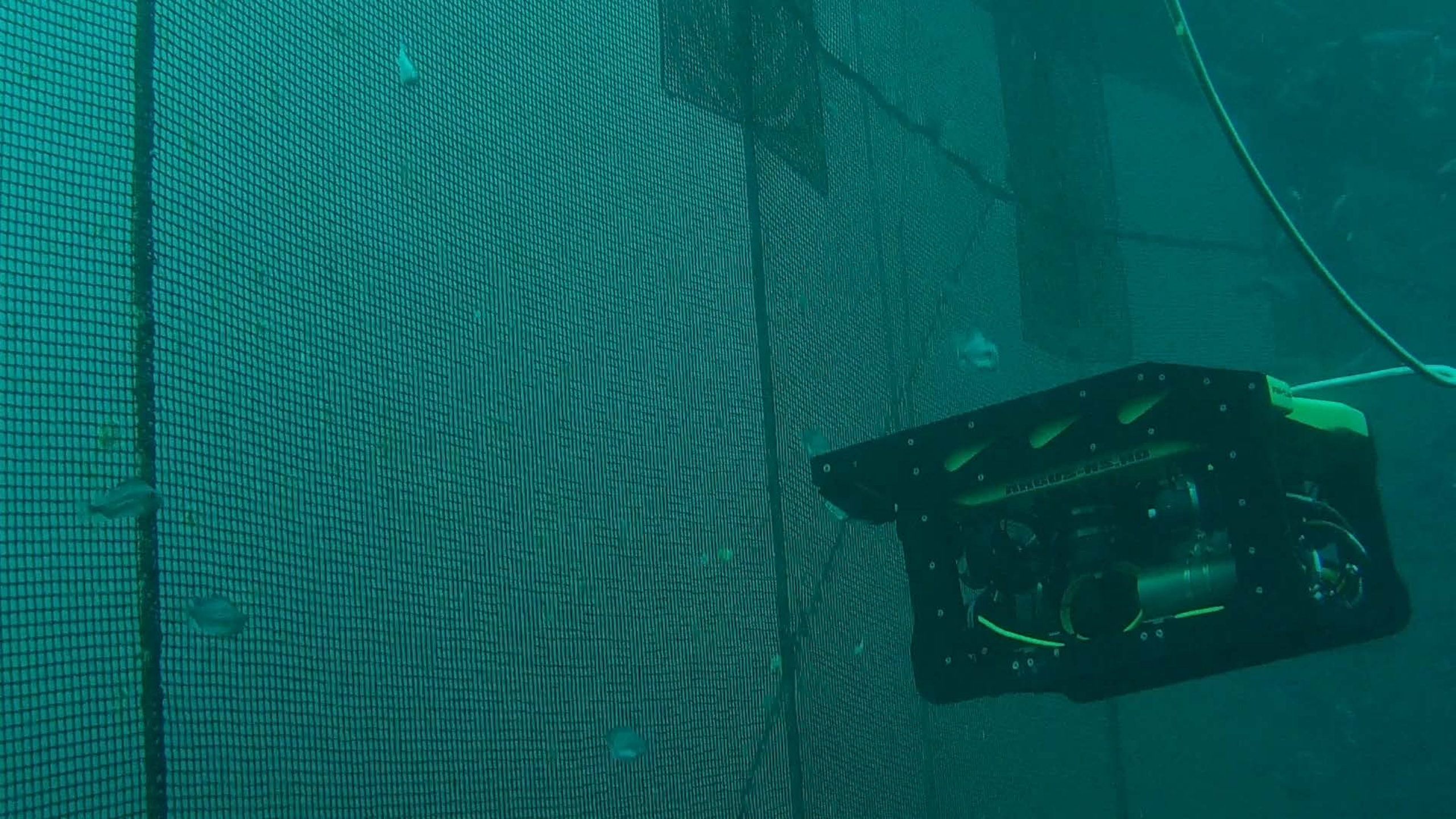
DIGITALE TVILLINGER OG ROBOTER PÅ VEI TIL DIN LOKALITET

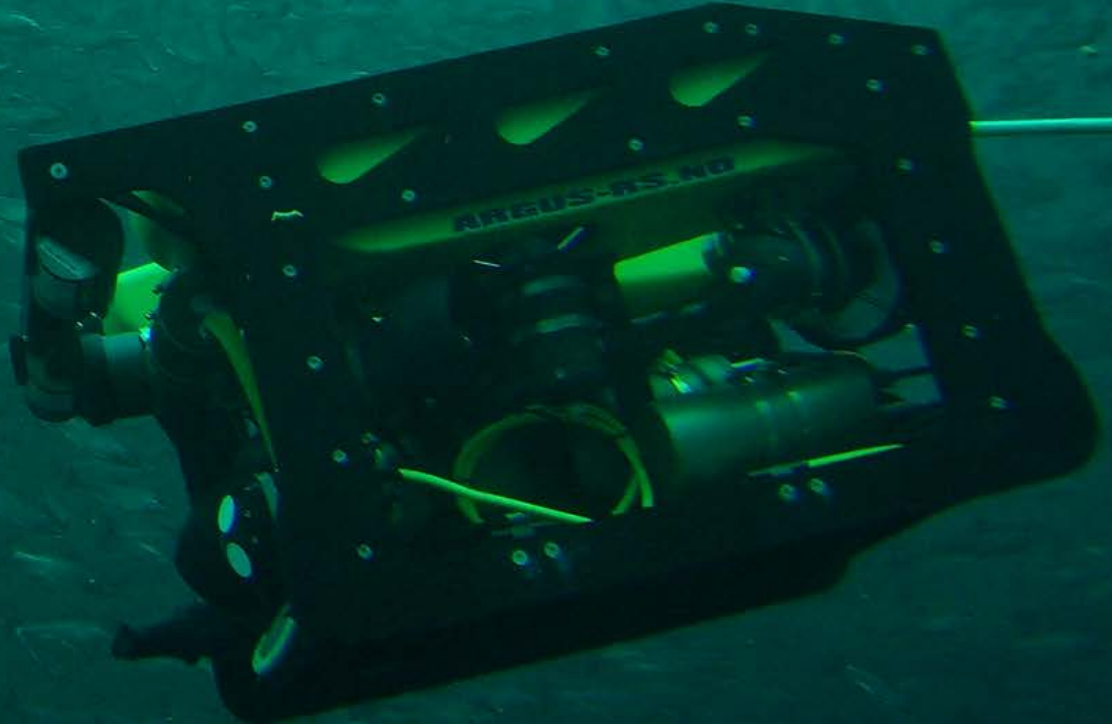
Sveinung Johan Ohrem, Forskningsleder Havbruksrobotikk og automasjon
SINTEF Ocean







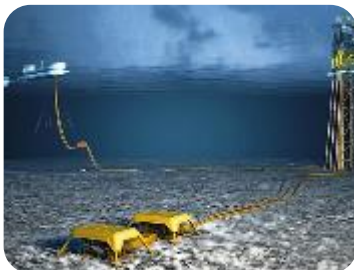






SINTEF

Undervannsrobotikk i ulike domener



Olje/gass



Miljøovervåkning



Forsvar



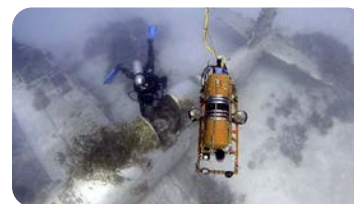
Havbruk



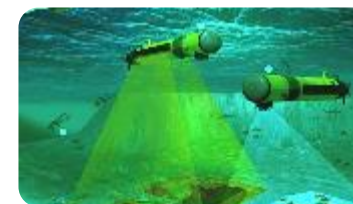
Telekom



Konstruksjon, inspeksjon,
vedlikehold



Arkeologi



Leteaksjoner

Dirty

Dangerous

Distant

Dull

Dear



SINTEF



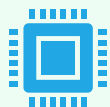
Vanskelige og komplekse miljø-
Operasjoner i bølgesonen,
eksponerte lokasjoner



Fleksible strukturer og
deformasjoner – Operasjoner i
dynamiske miljø



Biomasse – 200.000 fisk i merdene



Risikable og kostbare operasjoner

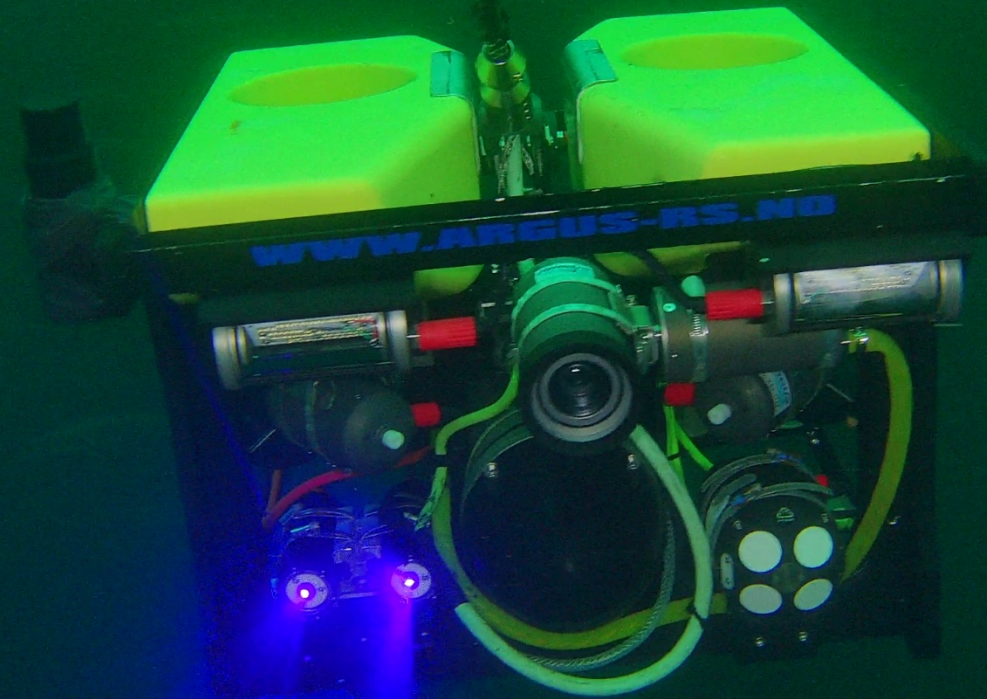


Utfordringer:

- Komplekse miljø/bølgesone
- Dynamiske miljø (strukturer/fisk)
- Posisjonering/navigasjon

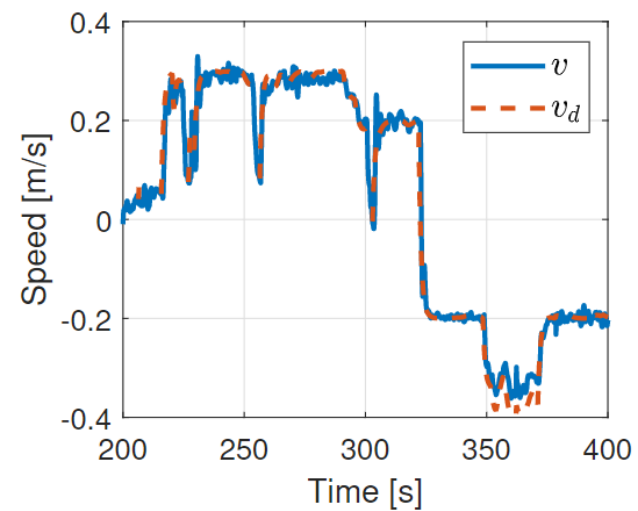
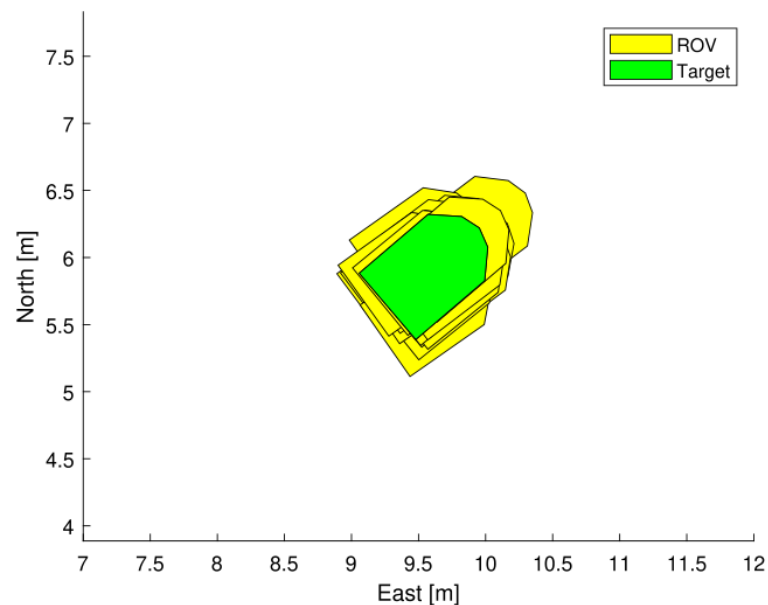
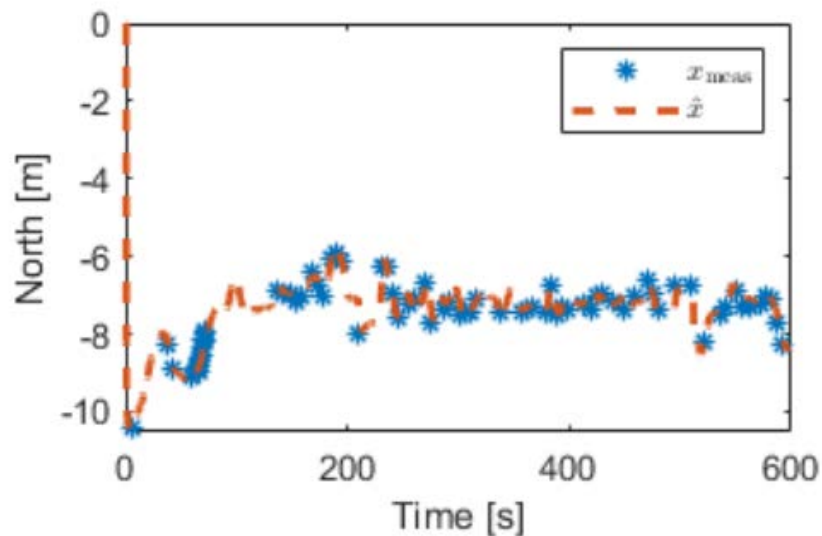
Løsninger:

- Robust kontroll
- Økt autonomi
- Lokal navigasjon
- Digitale tvillinger

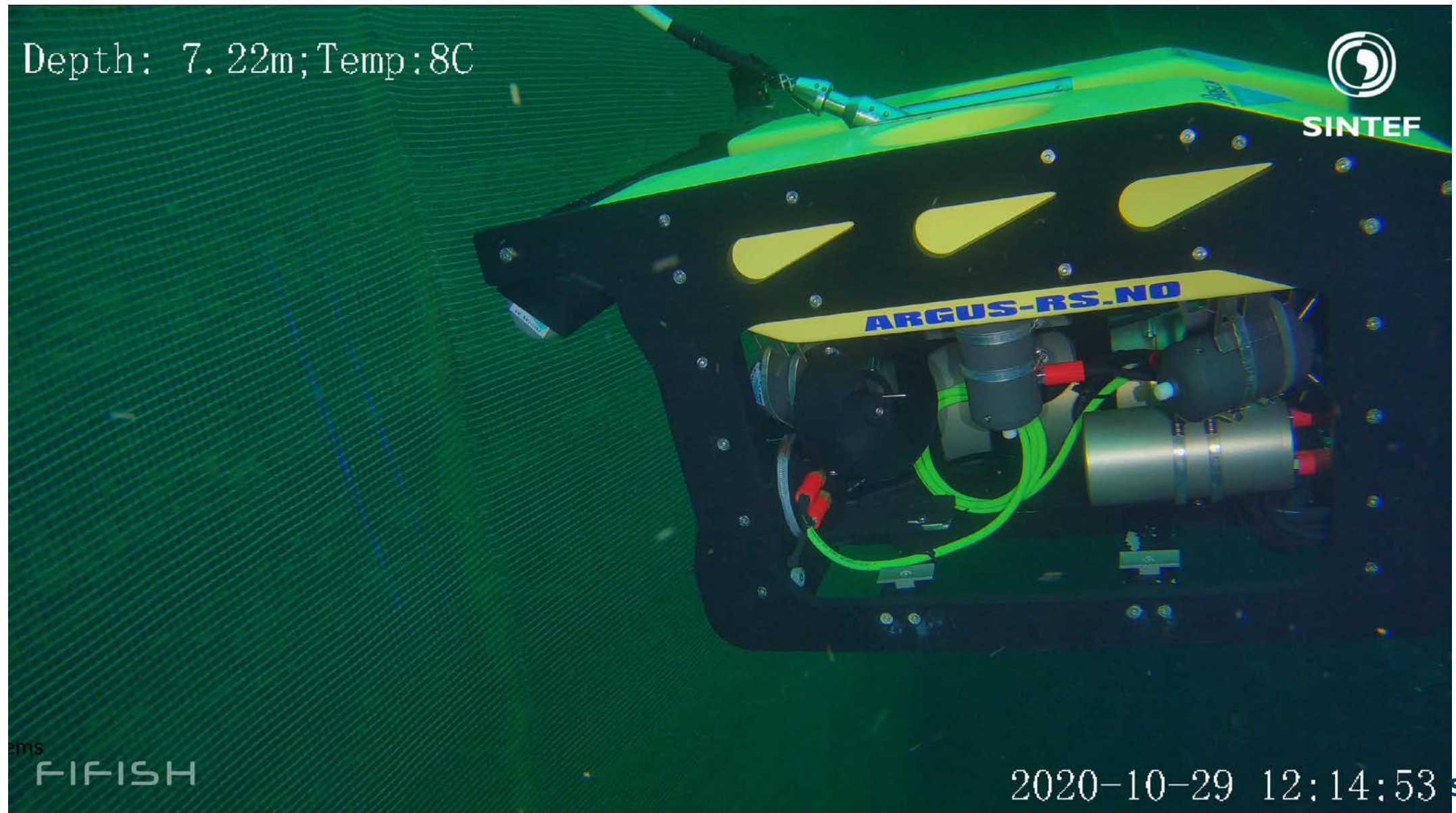


Robust kontroll

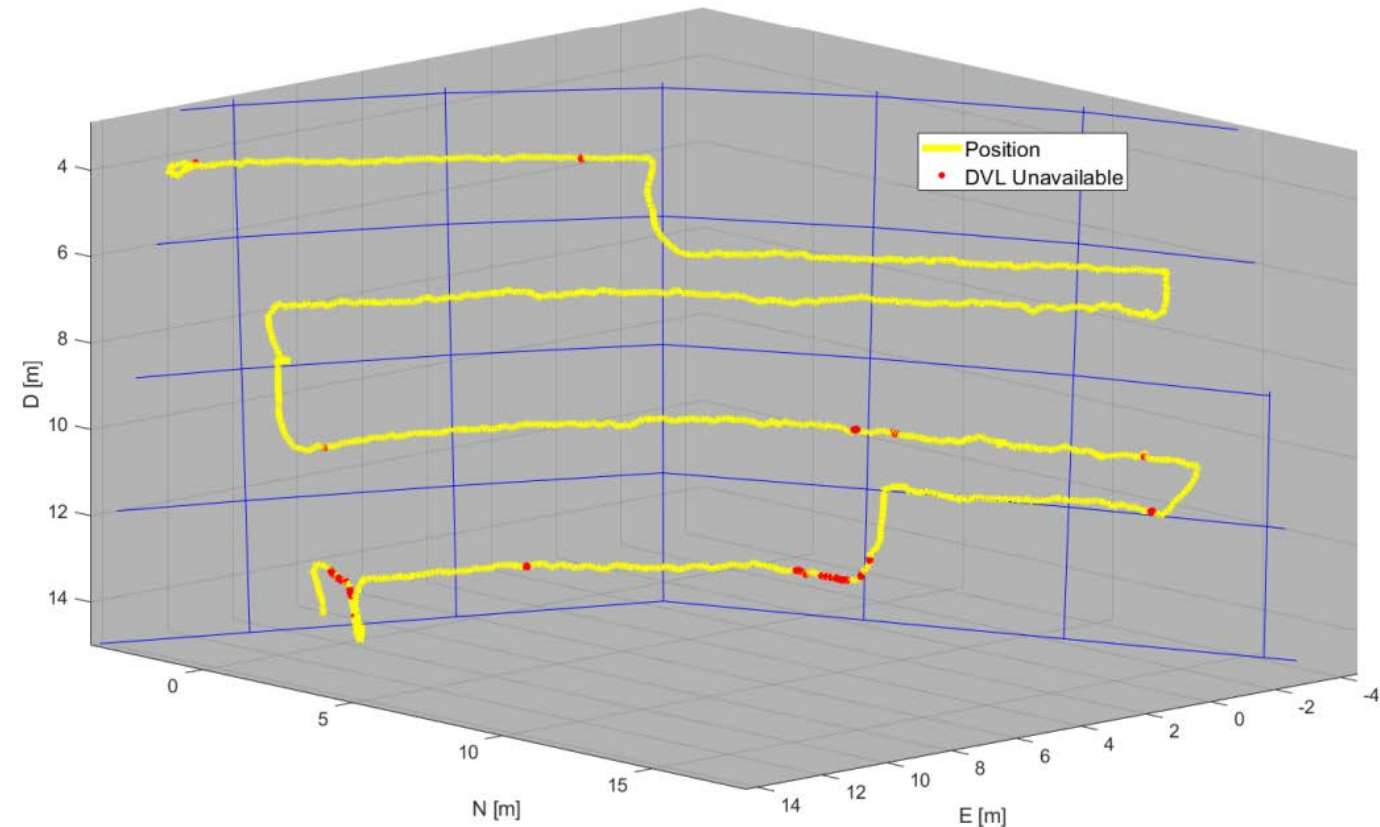
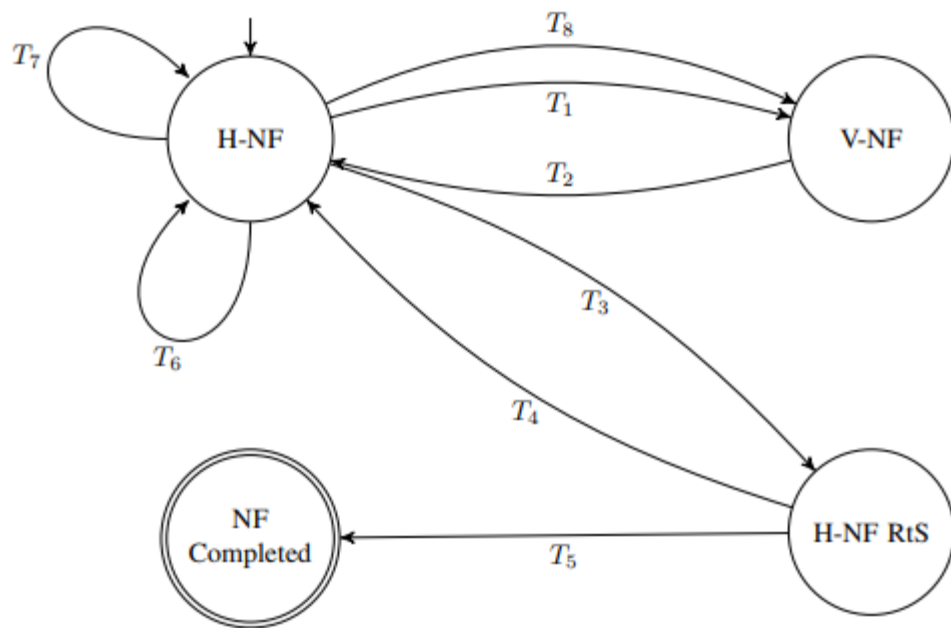
- Extended Kalman Filter (EKF) for tilstandsestimering og filtrering
- Dynamisk posisjonering
- Robuste hastighetsregulatorer



Økt autonomi – Notfølgning

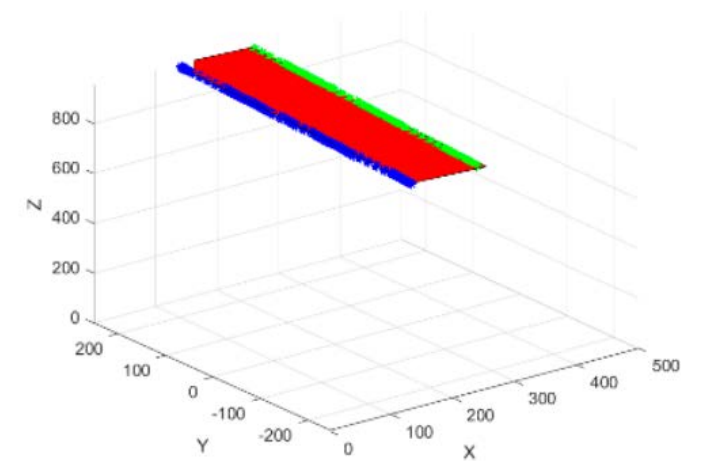
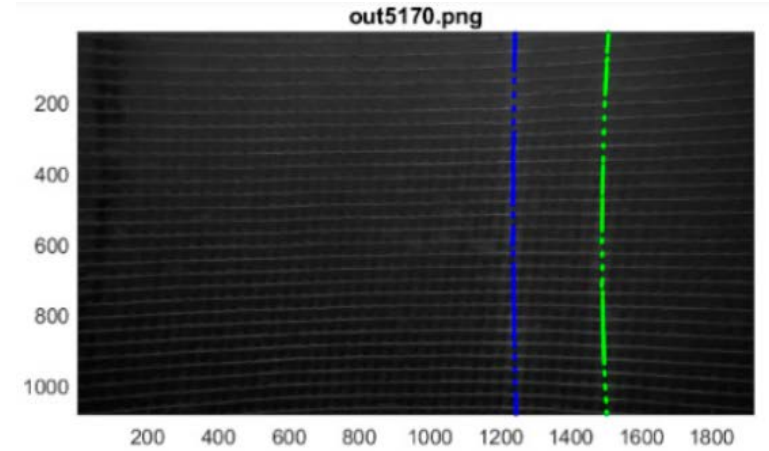
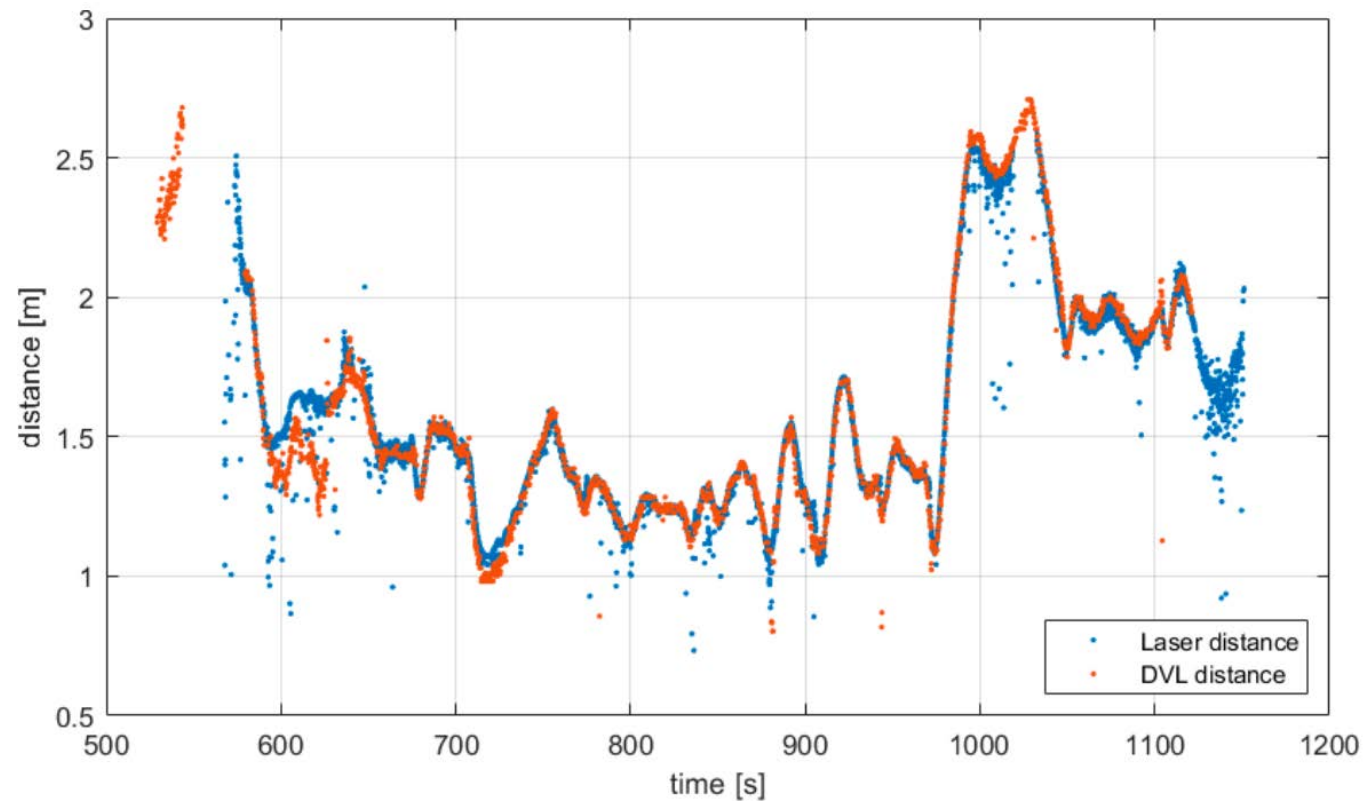


Økt autonomi – Autonome oppdrag



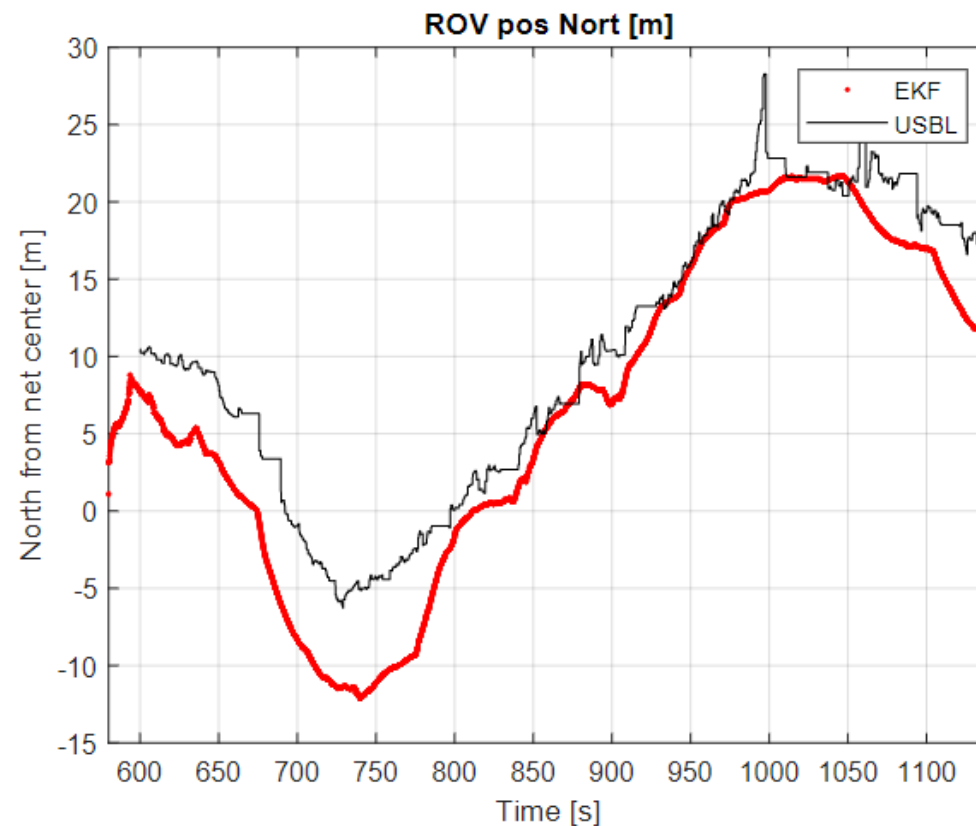
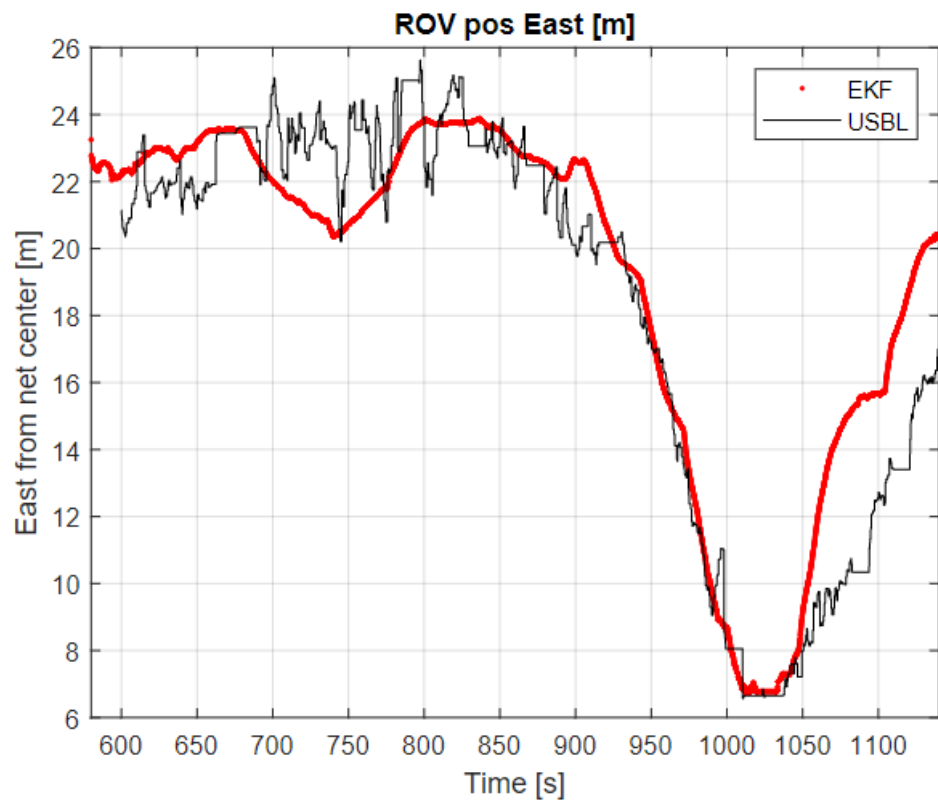
Lokal navigasjon

- Laser-kamera triangulering

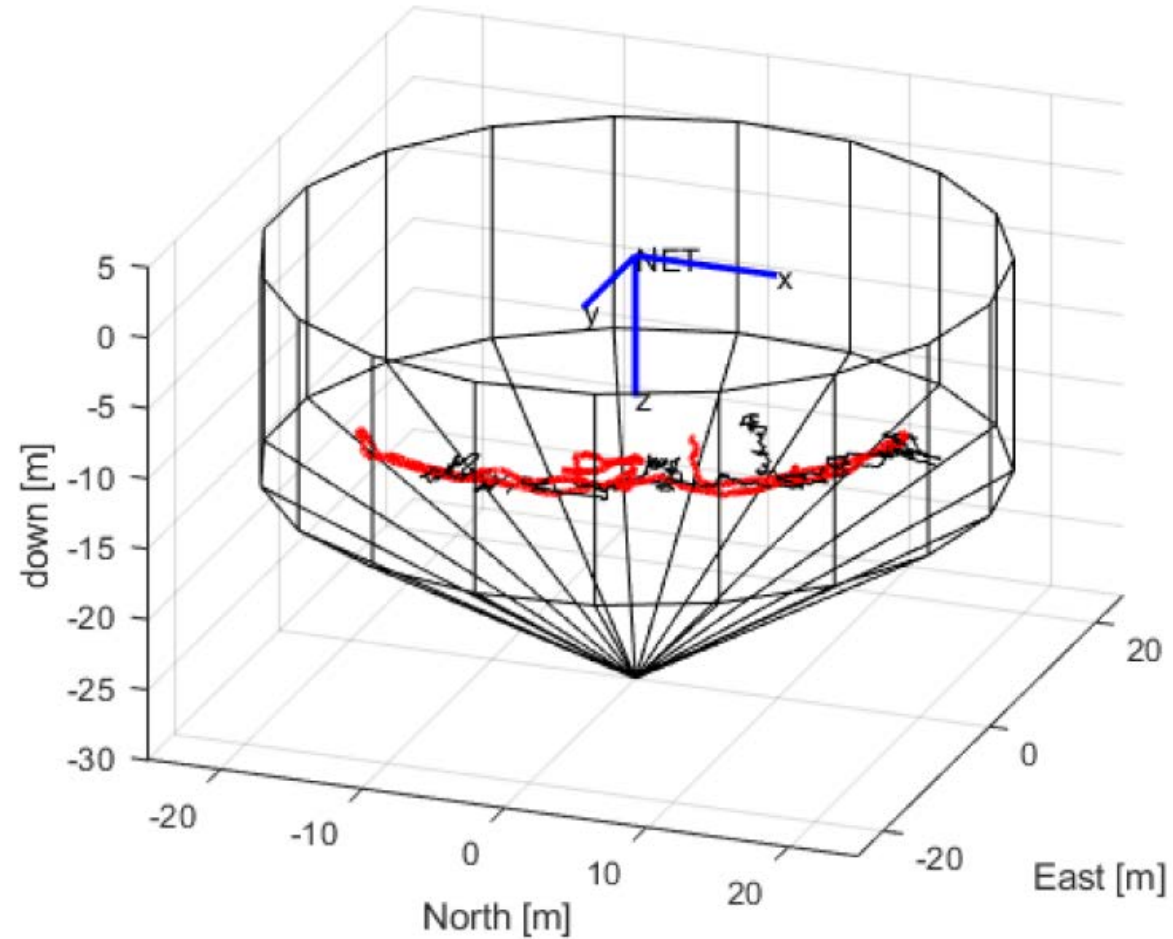


Lokal navigasjon

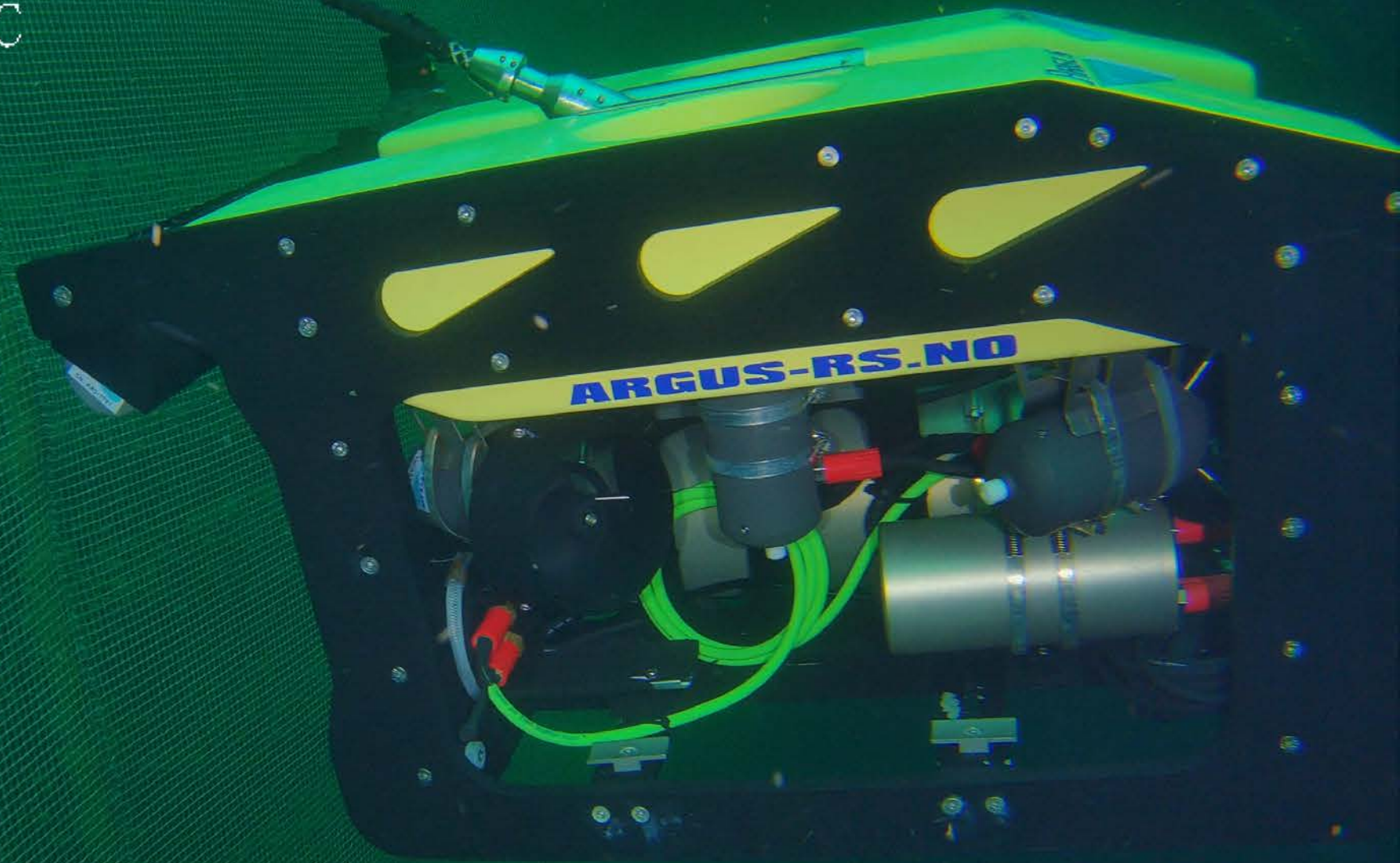
- Posisjonsestimering fra laser-kameramålinger



Lokal navigasjon



Depth: 7.22m;Temp:8C



FIFISH

2020-10-29 12:14:52



Simulation time: 60 880000

Time: 2022- 6-10T11:52:43; Location: Rataren #2

WinDir: 4.119rad; WinSpd: 0.000m/s

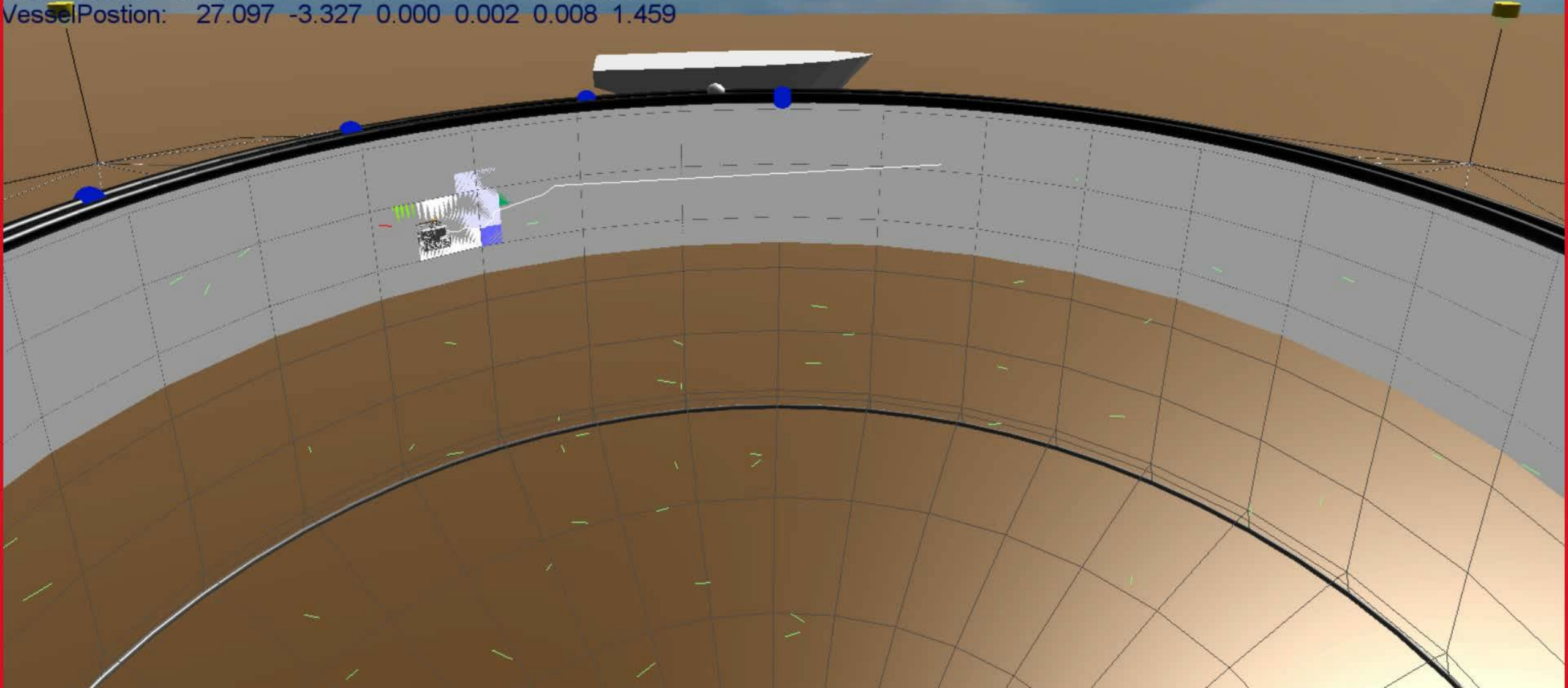
WavDir: 1.701rad; Hs: 0.029m; Tm: 3.906s

CurDir: 5.610rad; CurSpd: 0.064m/s

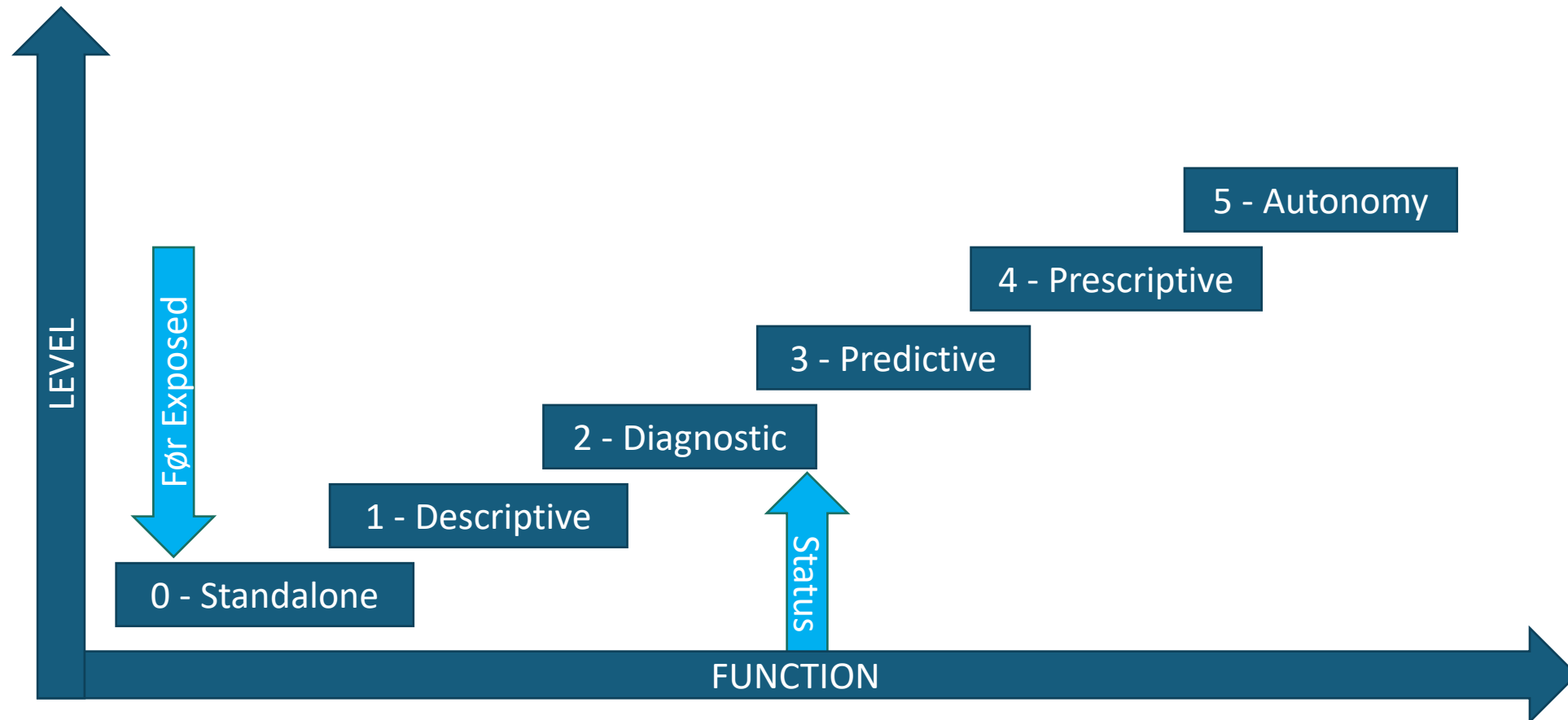
LoadData: 0.000 0.000 0.000 0.000

ROVPosition: 17.676 -15.420 3.998 0.000 0.000 5.641

VesselPosition: 27.097 -3.327 0.000 0.002 0.008 1.459

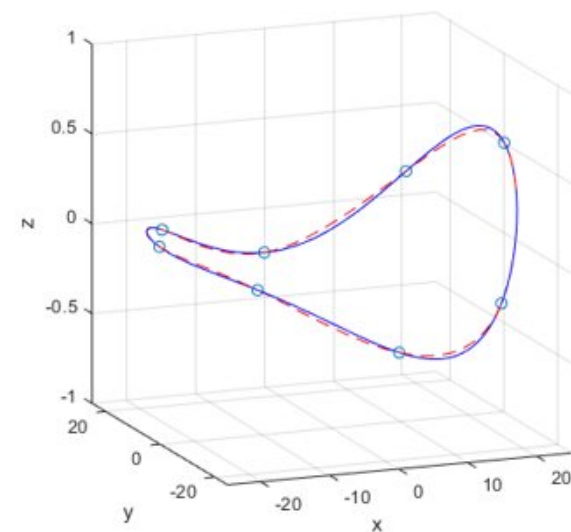
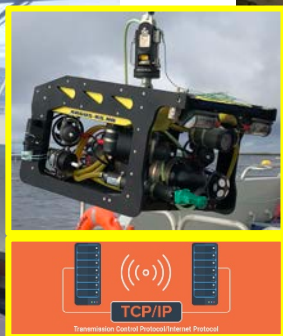
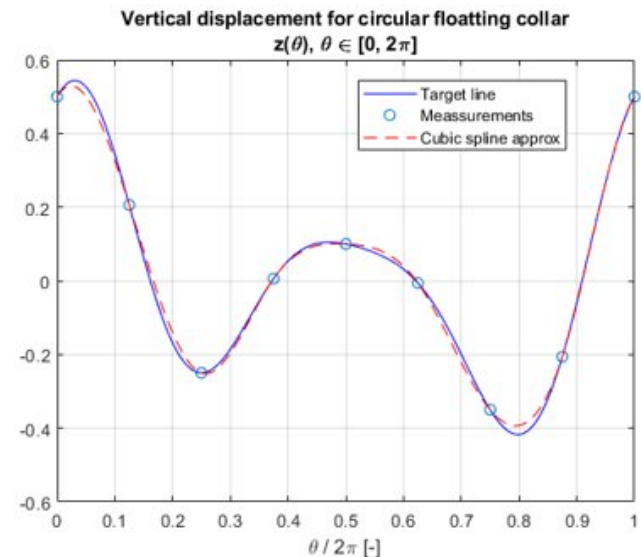


Digitale tvillinger – ulike nivå



Digitale tvillinger – Hvordan?

- Startet med avanserte fysikkbaserte modeller
- Reduserte kompleksitet – muliggjør sanntid
- Modellene mates med data fra sensorer i sanntid



Kontrollrom for fjernoperasjoner/digitale tvillinger



Fremtidsutsikter

- Flere roboter entrer merdene – fler operasjoner muliggjøres
- Havbruk til havs og eksponert havbruk øker behovet for robotikk og digitale tvillinger
- Økt grad av autonomi og digitale tvillinger kan muliggjøre nye produksjonssystemer



Teknologi for et bedre samfunn