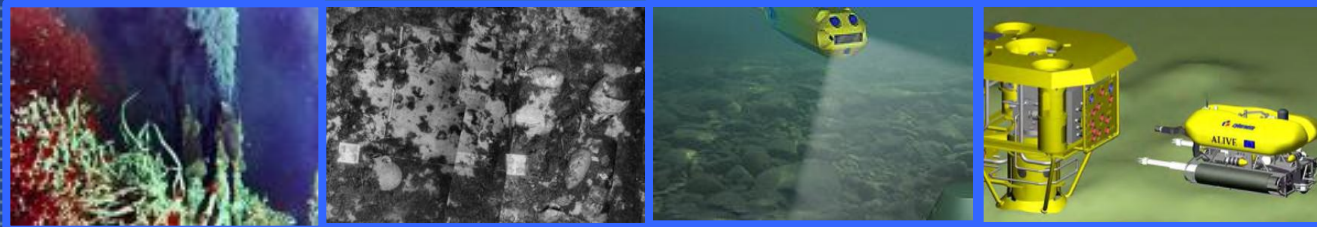


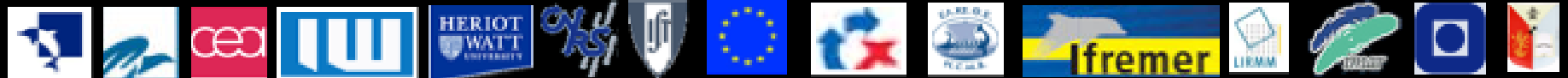
# Mid Term Review

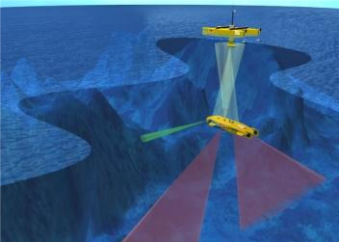
## Andreas J. Häusler



# FREEsubNET

MCRTN-CT-2006-036186





# Andreas Häusler



**Country of Origin:** Germany

**Host Organisation:** IST Lisbon

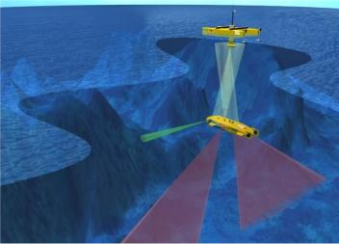


**Start Date:** August 1<sup>st</sup>, 2007

**Project Title:** Cooperative Navigation and Motion Control of Multiple Autonomous Marine Vehicles

**Contribution to Network:**

FSN Tasks 1.0, 1.1, 1.2, 5.1, 5.2



## Achievements to date



**Publications:** 6 Internal Reports, Seminar Talks

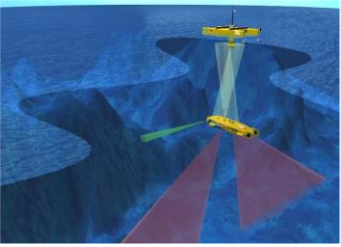
**Workshops & conferences:** NGCUV '08

**Participation in tests:** GREX Azores '08

**Secondments:** NTNU Norway, Fall '09

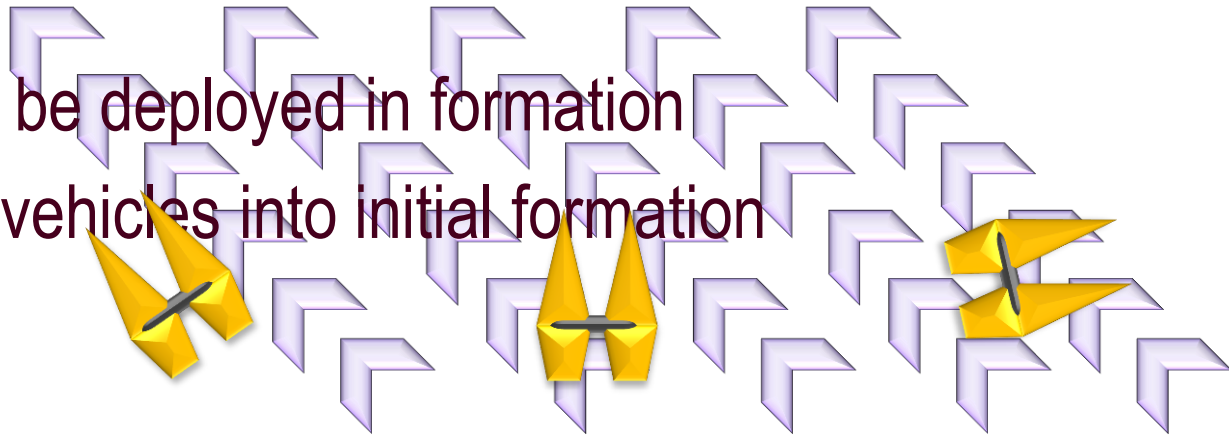
**Training:** Lectures on Dynamical Linear and Non-Linear Systems and Optimization, Seminars on current topics of research

# Technical Summary

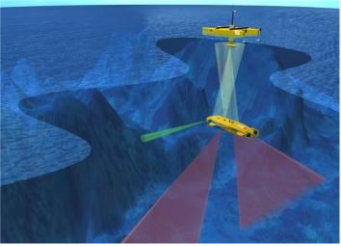


## The Problem

- Multiple vehicle missions require the vehicles to be in formation
  - An initial formation has to be established before the mission starts
  - Vehicles cannot be deployed in formation
- ⇒ Need to get the vehicles into initial formation



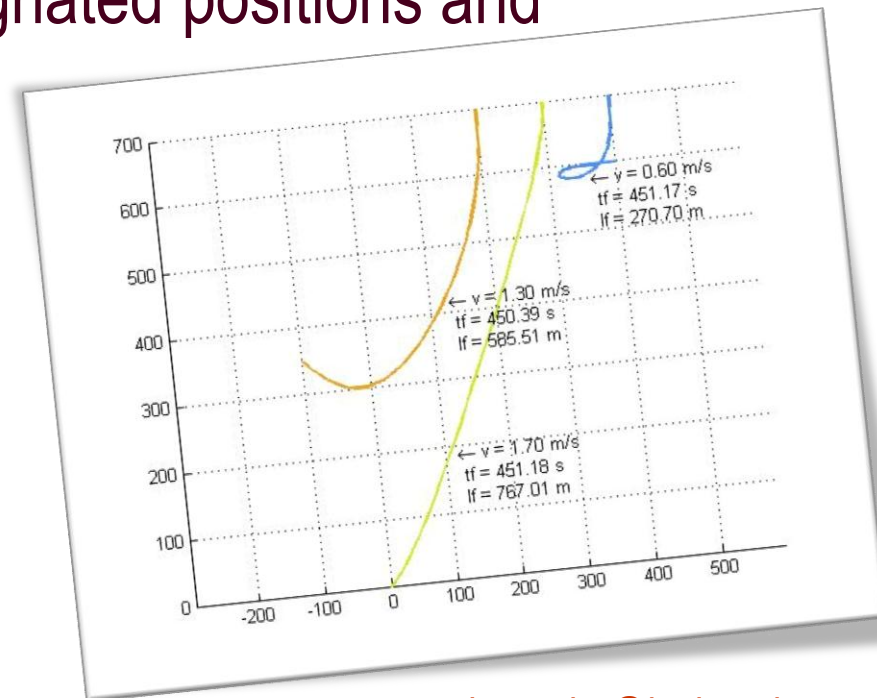
# Technical Summary

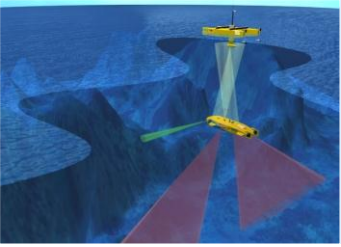


## The solution

Rigorous solution based on optimization techniques and a new polynomial path parametrization:

- 1 Simultaneous arrival at designated positions and orientations
- 2 Avoid collisions until mission control takes over
- 3 Consider time, energy and vehicle constraints

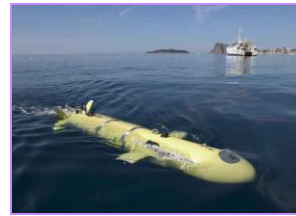




# Coordinated Target Tracking



**Moving Target**



*Sonar, GPS, acoustic data*

*Leading pursuer*

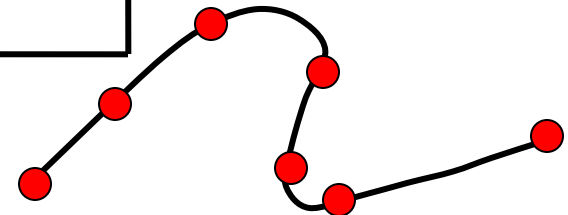
**Data Smoothing**

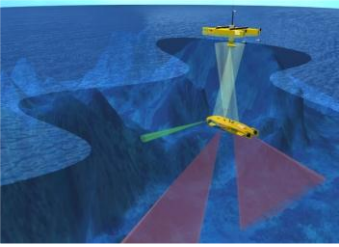


**Cooperative Path Following**

**Path Fitting**

*Path Sequence*





# Technical Summary



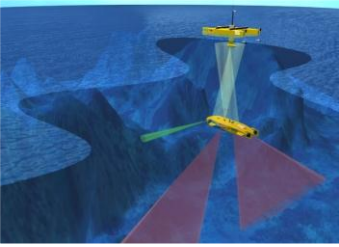
## Related Work within *FREE<sub>sub</sub>NET*

- How do we deal with “deviations from the plan”? (wind, currents, etc.)
  - ⇒ Use cooperative path following! (Methods are available – IST, NTNU)

## First Results

(see the video)

[LINK TO THE VIDEO](#)



# Collaborative work



## Work with other members of the Network (ToK)

Yana Lizunkova (UWTH)

Mara Schmiing (IMAR)

Mernout Burger (NTNU)

Francesco Orsenigo (HCMR)

Fausto Ferreira (CNR)



## Work with other institutions

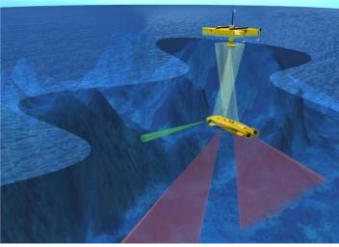
NTNU: Developing Algorithms on Path Planning and Path Following



IMAR: GREX Azores '08 Sea Trials







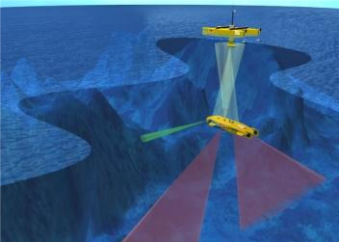
# Forward Plan



## Technical Plan

WorkPlan

	Year 1				Year 2				Year 3			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Literature Review on Cooperative Path Planning/Mission Planning	X											
Gaining knowledge in fundamentals of Control	X	X	X	X								
Understand general issues on path planning		X	X									
Development of Algorithms for spatial deconfliction			X	X	X	X						
Gaining knowledge of optimization techniques				X	X							
Extension to 3D, temporal deconfliction						X	X	X	X			
Data-driven online planning							X	X	X	X		
Experimental Validation in underwater environment			X				X				X	
Incorporate static obstacle avoidance, development of mission control tool									X	X	X	
Write Up										X	X	X



# Forward Plan



## Collaborative Plan

### Collaboration Plan

Date	Action	Outcome
July 2008	GREX Azores '08 Sea Trials	Assistance Software for Coordinated Path Following and Coordinated Target Tracking behaviours
Fall 2009	Secondment to NTNU, Norway	
Oceans 09	Scientific Contribution	Survey on Path Planning, Work on Path Generation
	WP2 Workshop	
2010	Secondment to CNR, Italy	
2010	FSN Summer School at the Azores	