# MUN Explorer AUV

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## 1 Introduction

In June 2006 the Memorial University of Newfoundland (MUN) acquired an Autonomous Underwater Vehicle (AUV). The research group chair is Dr. Neil Bose in the Department of Engineering and Applied Science, along with research laboratory coordinators Sara Adams and Moqin He. I participated in an international exchange funded by Collaborative Autosub Science in Extreme Environments (CASEE) and spent 5 weeks, from 26 June to 31 July 2006, in St. John's, Newfoundland to work with the MUN Explorer AUV (Figure 1(a)). The goal of this visit was to learn about AUVs and to explore the possibility of taking the MUN Explorer to the Greenland Sea to map chimneys.

(a) Front view, with CTD

(b) Rear propeller and four aft planes

Figure 1: The MUN Explorer 27-B02-3000 AUV

The MUN explorer AUV and several proposed missions are described in [1]. The specifications of the vehicle are summarised in Table 1. The body is cylindrical, with a nose and tail designed to minimise drag. It is propelled by a $0.6m$ diameter 2-blade propeller (see Figure 1(b)), and has dynamically controlled depth, roll, pitch, yaw and axial speed: the depth is controlled by the two fore planes and the attitude and course is controlled by four aft planes in an x-configuration. In addition to the internal navigation system and other instruments needed to control the vehicles path, it has the capability of carrying $150kg$ of scientific payload.

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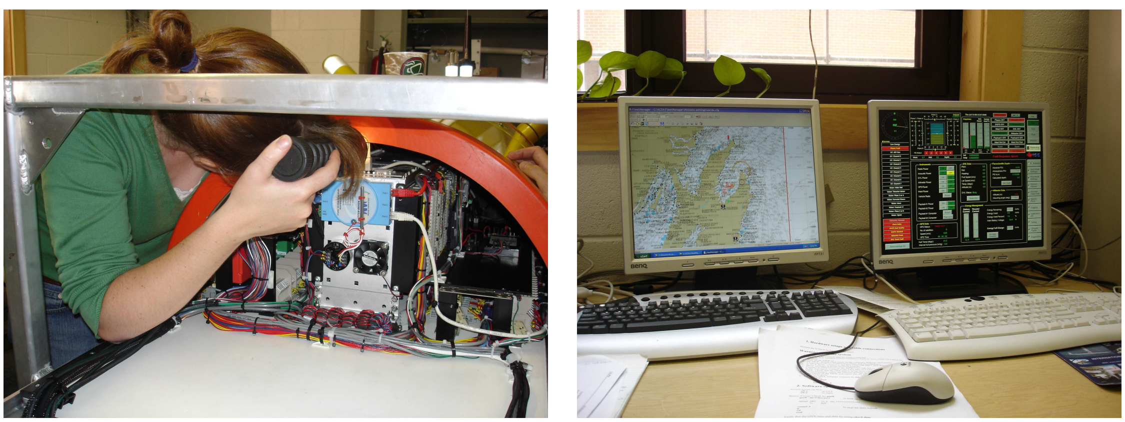
|---:|---|
| Length | $4.5m$ |
| Body Diameter | $0.69m$ |
| Beam (including fore planes) | $1.49m$ |
| Height (including aft planes) | $0.97m$ |
| Maximum Speed | $2.5m\ s^{-1}$ |
| Maximum Depth | $3000m$ |
| Turning Radius | $10m$ |

Table 1: MUN Explorer AUV technical specifications.



(a) VCC

(b) MPW and SCC

Figure 2: Computers that control the MUN Explorer AUV

The Vehicle Control Computer (VCC) is housed inside a pressure hull in the middle of the vehicle (see Figure 2(a)). The VCC collects data from all the instruments and controls the execution of missions. This computer can remotely communicate with a Surface Control Console (SCC) while it is on the surface (see Figure 2(b)). The SCC transmits pilot commands to the VCC and creates graphical displays to provide information to the operator. Both of these machines run the QNX operating system. Before the AUV is put in the water, missions are planned on the Mission Planning Workstation (MPW) (see Figure 2(b)), which runs Windows XP. The MPW runs the software FleetManager to provide graphical chart displays and mission planning capabilities.

## 1.1 AUVs in the Arctic

Data acquisition in the Arctic Seas is problematic due to adverse weather conditions during much of the year, including sea ice cover. Autonomous Underwater Vehicles provide a platform from which to collect accurate data efficiently in regions where it would otherwise not be possible. As they are unmanned, they can be sent to more hazardous underwater environments. AUVs are already used to study sea ice from below in both the Arctic and the Antarctic (see, for example, [3], [2]).

## 1.2 Mission Planning for MUN Explorer

The MUN Explorer AUV was delivered to St. John's just before my arrival. I was present for the planning of the first missions, which took place in Holyrood Harbour (see Figure 3) after my departure at the end of August and beginning of September. The tests done during this time were as follows:

1. Piloting the AUV from the SCC,
2. Simple autonomous missions on the surface,
3. Simple autonomous missions at small depths,
4. Manoeuvre tests such as acceleration, deceleration and turning circles,
5. Mapping a plume of fresh water.

After reading the user's manuals, my main role was to use the FleetManager software on the MPW to design some of the simple missions that were to be executed at the beginning of the first field experiment. An example of such a mission is shown in Figure 4. A short mission, with $70m$ segments is shown in red. A longer mission with $250m$ segments is shown in blue. These missions were designed to be executed at a variety of depths from 0-$2m$ and at a variety of speeds between 1.5-$2.5m\ s^{-1}$.

Figure 3: Holyrood Harbour, where the first tests with the MUN Explorer AUV were done in August 2006

## References


[1] N. Bose, J. Ferguson, and S. Adams. MUN Explorer AUV - autonomous underwater vehicle. MAHY, January 2006.

[2] K. W. Nicholls, E. P. Abrahamsen, J. J. H. Buck, P. A. Dodd, C. Goldblatt, G. Griffiths, K. J. Heywood, N. E. Hughes, A. Kaletzky, G. F. Lane-Serff, S. D. McPhail, N. W. Millard, K. I. C. Oliver, J. Perrett, M. R. Price, C. J. Pudsey, K. Saw, K. Stansfield, M. J. Stott, P. Wadhams, A. T. Webb, and J. P. Wilkinson. Measurements beneath an antarctic ice shelf using an autonomour underwater vehicle. *Geophysical Research Letters*, 33(8):L08612, April 2006.

[3] P. Wadhams, J. P. Wilkinson, and A. Kaletzky. Sidescan sonar imgery of the winter marginal ice zone obtained from an auv. *Journal of Atmospheric and Oceanic Technology*, 21(9):1462–1470, September 2004.

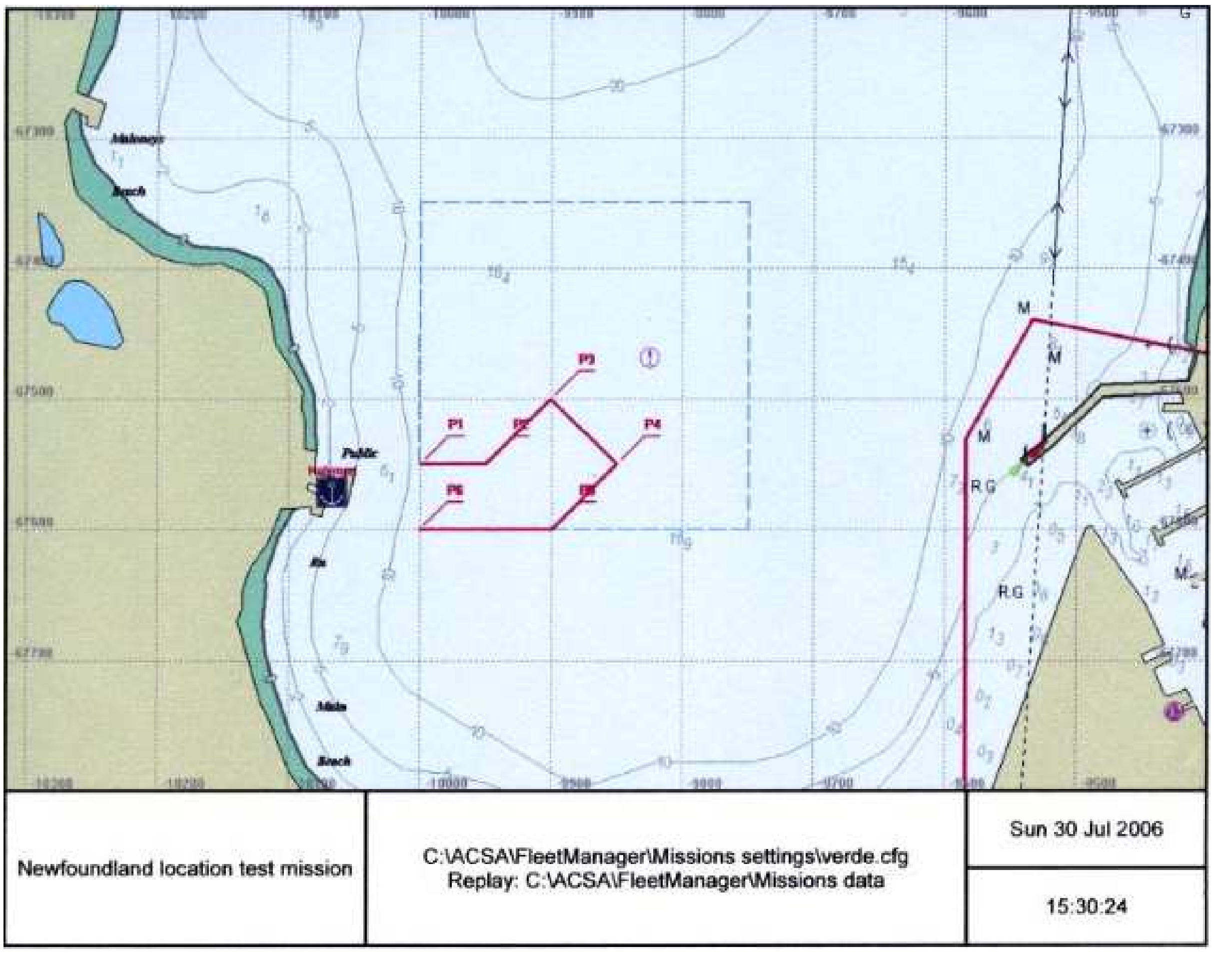



Figure 4: Graphical display of mission route on a map of Holyrood Harbour