

# UNDERSEA: An Exemplar for Engineering Self-Adaptive Unmanned Underwater Vehicles (Artifact)

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## Abstract

Recent advances in embedded systems and underwater communications raised the autonomy levels in unmanned underwater vehicles (UUVs) from human-driven and scripted to adaptive and self-managing. UUVs can execute longer and more challenging missions, and include functionality that enables adaptation to unexpected oceanic or vehicle changes. As such, the *UNDERSEA* artifact facilit-

ates the development, evaluation and comparison of self-adaptation solutions in a new and important application domain. *UNDERSEA* comes with predefined oceanic surveillance UUV missions, adaptation scenarios, and a reference controller implementation, all of which can easily be extended or replaced.

**1998 ACM Subject Classification** D.2.13 [Reusable Software] Domain Engineering, I.2.9 [Robotics] Autonomous Vehicles

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## 1 Scope

UNDERSEA is an artifact designed to help researchers to quickly explore, develop, evaluate and compare new self-adaptation solutions in the unmanned underwater vehicle domain. The artifact is developed on top of the open-source middleware MOOS-IvP, a widely used platform for the implementation of autonomous applications on UUVs [1]. UNDERSEA adopts the conventional MAPE-K control loop [2] and comprises a simulated managed system (UUV) and its controller. The artifact is extendable and other self-adaptation solutions (e.g., based on control-theory or



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stochastic search) can be developed easily. The exemplar is available preinstalled on an easy-to-use virtual machine and supports a range of UUV missions and adaptation scenarios. New missions and adaptation scenarios can be defined with limited effort.

### 2 Content

The artifact package contains:

- An index.html file in directory UNDERSEA webpage with instructions for using this artifact
- A pre-configured Ubuntu Linux 16.04 Virtual Machine image that includes:
  - A README file with information about the VM contents
  - Source code for using and extending MOOS-IvP
  - A development directory (UNDERSEA) which includes:
    - \* Source code for developing a controller (UNDERSEA\_Controller)
    - \* Source code for modifying UNDERSEA DSL
    - \* Example mission configuration files (moos-ivp-UNDERSEA)
    - \* Shell scripts for building a mission and a controller

### 3 Getting the artifact

The artifact endorsed by the Artifact Evaluation Committee is available free of charge on the Dagstuhl Research Online Publication Server (DROPS). The latest version of our code is available on the project webpage [www-users.cs.york.ac.uk/simos/UNDERSEA](http://www-users.cs.york.ac.uk/simos/UNDERSEA).

### 4 Tested platforms

The Virtual Machine image is known to work on any platform running Oracle VirtualBox version 5 or above (<https://www.virtualbox.org/>) with at least 4 GB of free space on disk and at least 4 GB of RAM.

### 5 License

The artifact is available under GNU General Public License version 3 (<http://www.gnu.org/licenses/gpl>).

### 6 MD5 sum of the artifact

f5244203bc0816eef87655e06e37059e

### 7 Size of the artifact

3.74GB

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#### References

- 1 MichaelR. Benjamin, Henrik Schmidt, PaulM. Newman, and JohnJ. Leonard. Autonomy for unmanned marine vehicles with MOOS-IvP. In *Marine Robot Autonomy*, pages 47–90. 2013.
- 2 J.O. Kephart and D.M. Chess. The vision of autonomous computing. *Computer*, 36(1):41–50, 2003. doi:10.1109/MC.2003.1160055.