

Motivation

Why this matters ?

Communications across the water-air-interface (WAI) are essential for the air-space-sea-submarine integrated information network, enabling applications such as **industrial monitoring**, **seabed observation**, and **scientific exploration**.

Major Limitations

01

Electromagnetic Waves (EMWs)

Near-light-speed in air but suffer severe range limitations underwater due to polarization relaxation absorption and Rayleigh scattering.

02

Acoustic Waves (AWs)

Can propagate over tens of kilometers underwater but degrade rapidly upon entering the atmosphere.

We need a high-speed, reliable, cross-medium communication method.

Ultraviolet (UV) Communications



Low attenuation in both underwater and atmospheric channels (near-UV band).



Robust non-line-of-sight transmission due to strong Rayleigh / Mie scattering.

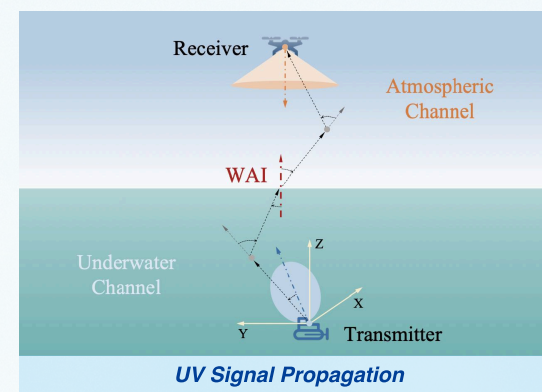
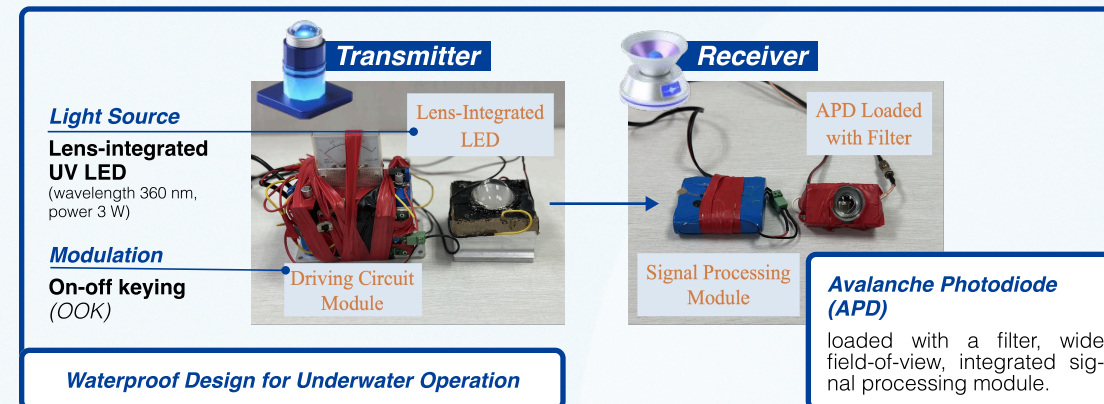


Reduced background noise due to minimal solar UV penetration.

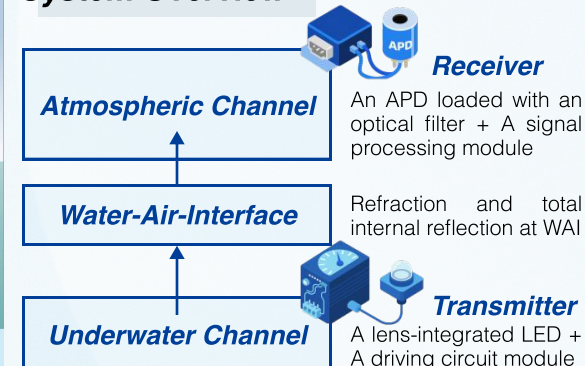
Innovation

What's new here ? How it works ?

This work presents a **hardware prototype** for UV communication across the WAI, **extending the transmitter-receiver separation from 30 cm (in prior work) to 10 m (5 m underwater + 5 m above water)**.



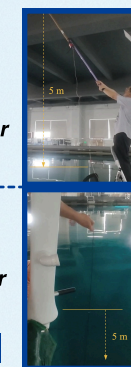
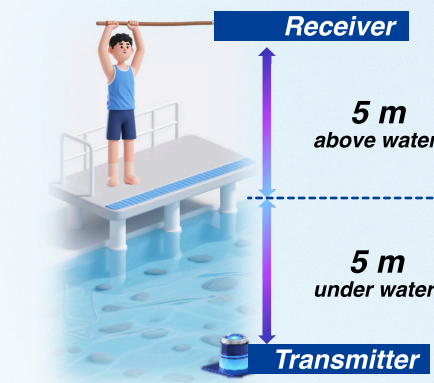
System Overview



Key Findings

What we achieved ?

Experimental Setup



Distance

Adjusted by changing the height of the rod

Wide-Angle Reception

Satisfactory data rates as an APD is oriented toward different directions

Experimental Scenario

Results

The received signal on an oscilloscope



Data rate: 116 kbps achieved over 10 m separation (5 m underwater + 5 m above water)

Stability: Works reliably despite receiver orientation changes

Feasibility: Validates UV communication across WAI for field deployment

Broader Impact

Why it matters for the future ?

- Provides an experimental foundation for UV-based communications across the WAI.
- Supports potential air-sea integrated networks for environmental monitoring, disaster rescue, and underwater exploration.
- Extends the practical reference value of UV cross-medium communication systems beyond laboratory-scale distances.