



HAL
open science

ROV-OPERATE: system engineering of an underwater ROV for early verification and automatic synthesis

Rodin Vincent, Vukšić Marko, Kovacevic Tonko, Đukić Predrag, Rogulj Roko, Šitić Slaven, Džaja Barbara, Turić Hrvoje, Zdroik Jakub, Tran Hai Nam, et al.

► To cite this version:

Rodin Vincent, Vukšić Marko, Kovacevic Tonko, Đukić Predrag, Rogulj Roko, et al.. ROV-OPERATE: system engineering of an underwater ROV for early verification and automatic synthesis. Conference BEING SEA-EU, University of Malta, Jun 2024, Malta, Malta. hal-04641877

HAL Id: hal-04641877

<https://hal.univ-brest.fr/hal-04641877v1>

Submitted on 9 Jul 2024

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Public Domain

Vincent Rodin^{*,4}, Marko Vukšić¹, Tonko Kovacevic¹, Predrag Đukić¹, Roko Rogulj¹, Slaven Šitić¹, Barbara Džaja², Hrvoje Turić², Jakub Zdroik³, Hai Nam Tran⁴, Val rie-Anne Nicolas⁴, Alain Plantec⁴, Laurent Lemarchand⁴, Frank Singhoff⁴

1- Department of Professional Studies/University of Split, Croatia, [✉ marko.vuksic@oss.unist.hr](mailto:marko.vuksic@oss.unist.hr)

2- Faculty of Sciences Split/University of Split, Croatia, [✉ bdzaja@pmfst.hr](mailto:bdzaja@pmfst.hr)

3- Department of Physical Oceanography and Climate Research/Univ. of Gdańsk, Poland [✉ jakub.zdroik@ug.edu.pl](mailto:jakub.zdroik@ug.edu.pl)

4- Lab-STICC UMR CNRS 6285/University of Brest, France, [✉ frank.singhoff@univ-brest.fr](mailto:frank.singhoff@univ-brest.fr)

*: Presenting author: [✉ vincent.rodin@univ-brest.fr](mailto:vincent.rodin@univ-brest.fr)

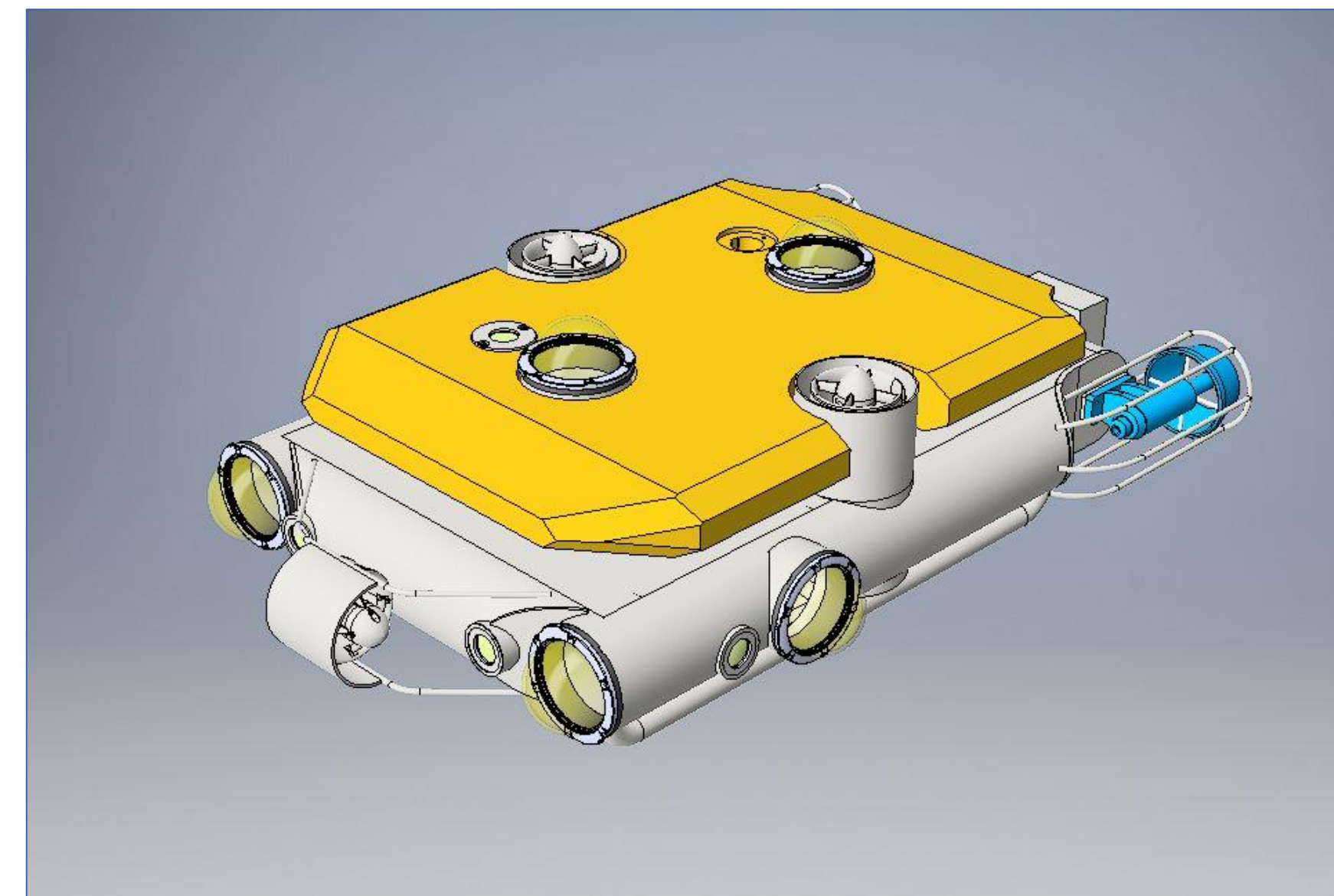
1 – Original ROV

- ❑ Very usable, lightweight, maneuverable underwater Remote Operated Vehicle (ROV)
- ❑ Diving down to 150 m depth
- ❑ Inspection of underwater electrical installation
- ❑ Umbilical cable is used to transfer data and electrical power
- ❑ Control by PS2 joystick console
- ❑ Developed by students and professors of the SOSS



2 – ROV under development

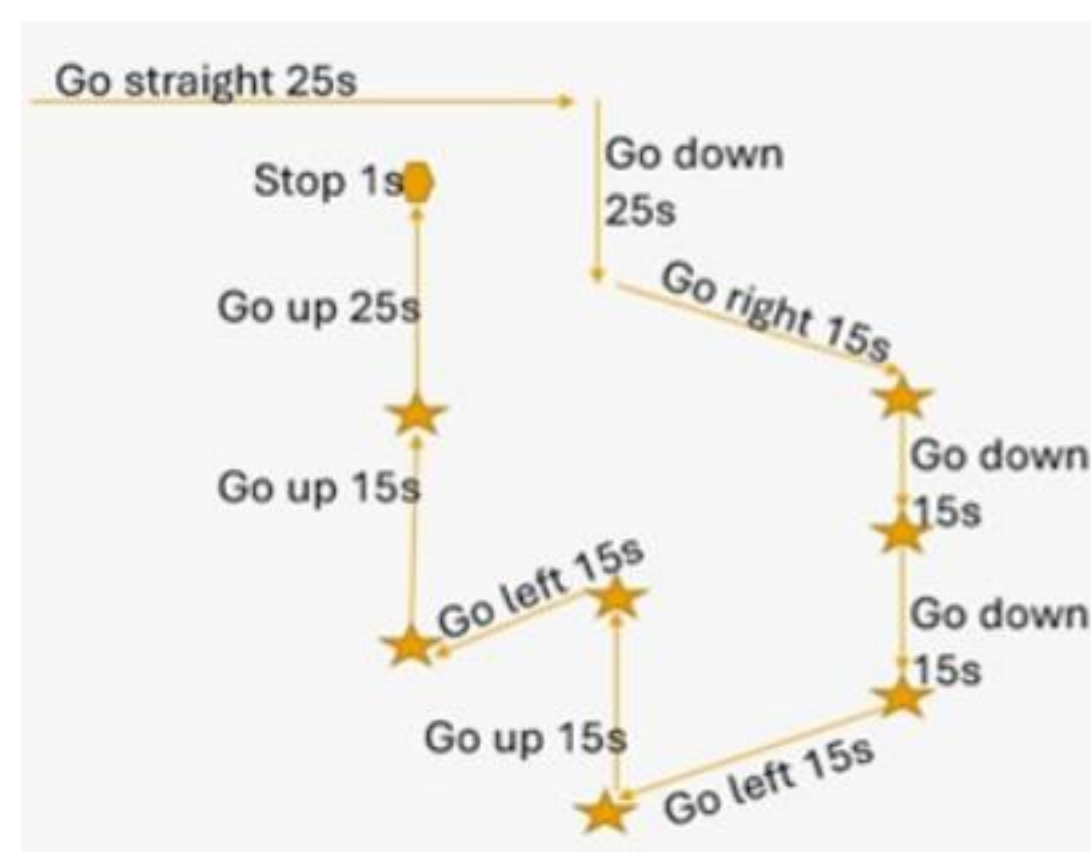
- ❑ Completely autonomous system (without cable)
- ❑ Battery powered - 2 x 625 Wh 36VDC
- ❑ Central control unit - ARK-1551-S6A1
- ❑ Dive control autopilot - Pixhawk 6X
- ❑ Surface control system - computer, joystick, tether interface and screen
- ❑ Advanced communication to surface – Visible Light Communication (VLC) and ultrasound



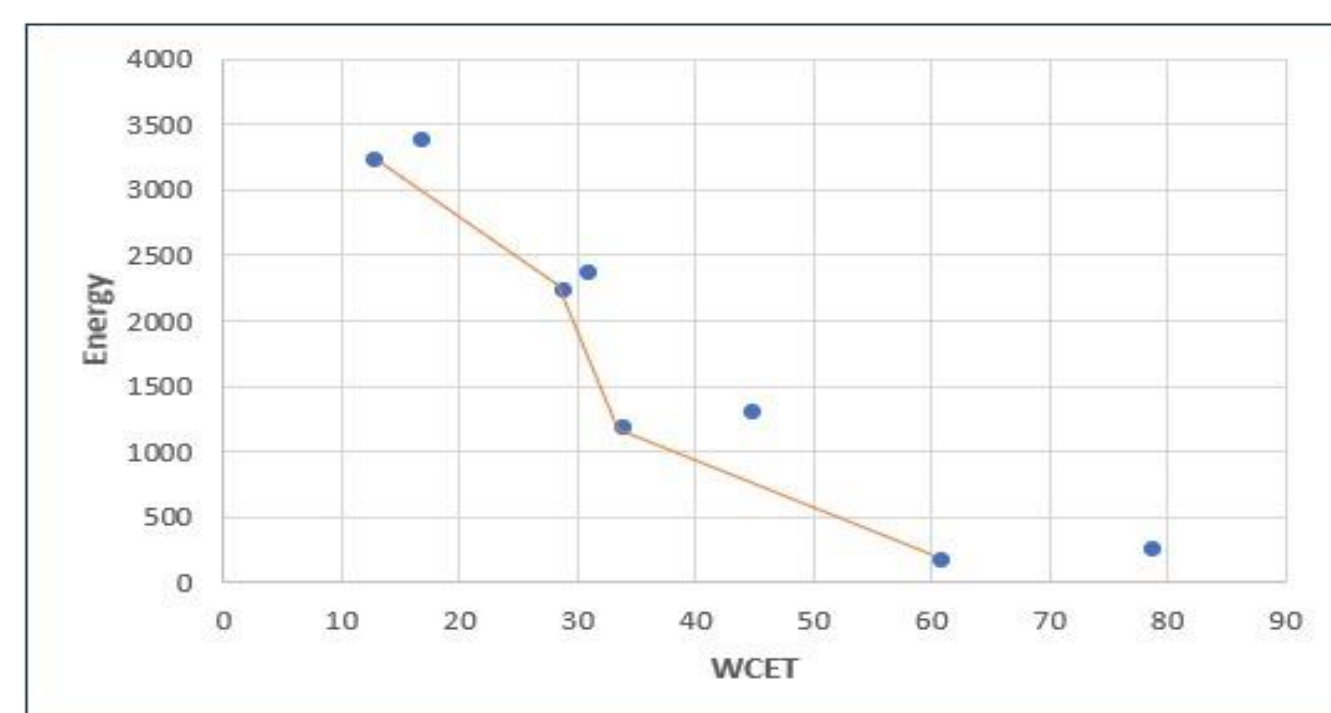
3 – Optimizing energy footprint

- ❑ Embed alternative hard/soft components for specific ROV mission achievement

Name	Task Type	Processor Name	Address Space	Capacity	Deadline	Start time	Priority	Blocking TI
GPS	Periodic	cpu1	ad1	2	10	0	1	0
data_encrypt	Periodic	cpu1	ad1	5	10	0	1	0
data_send	Periodic	cpu1	ad1	5	10	0	1	0
down1	Scheduling	cpu1	ad1	25	50	50	1	0



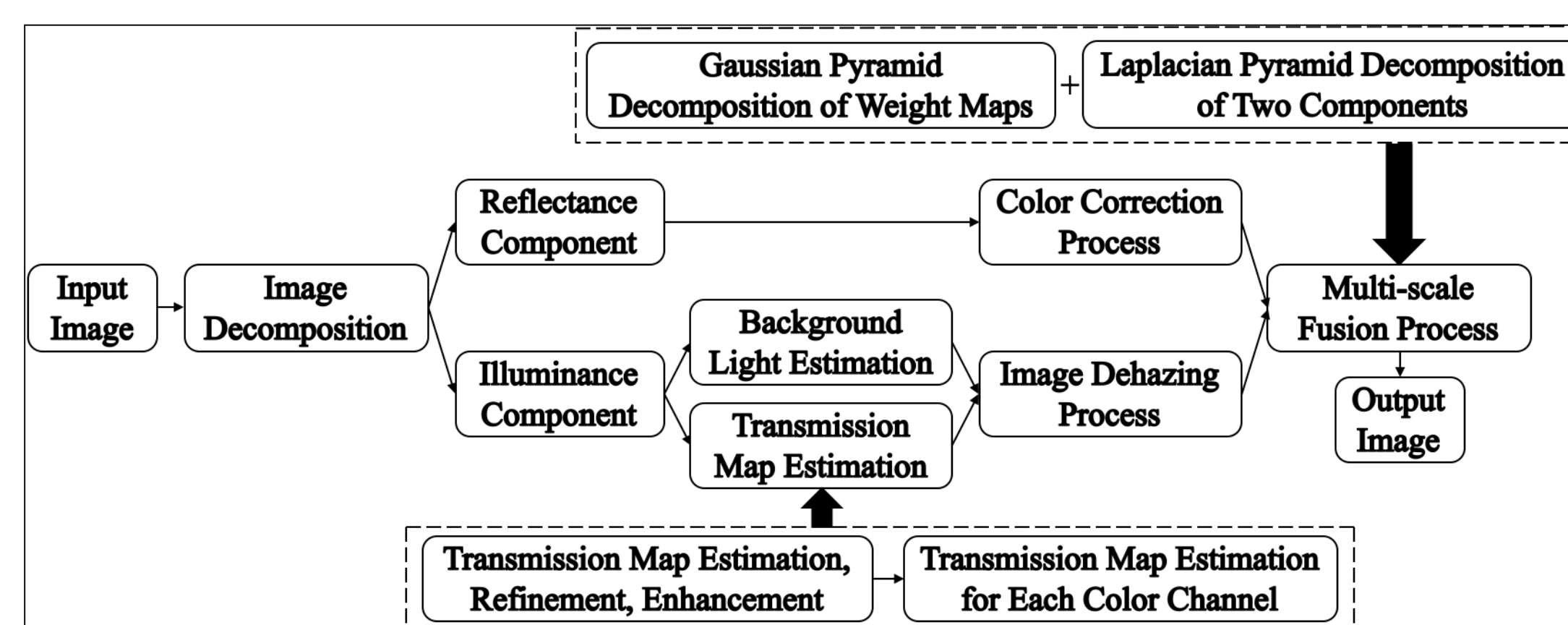
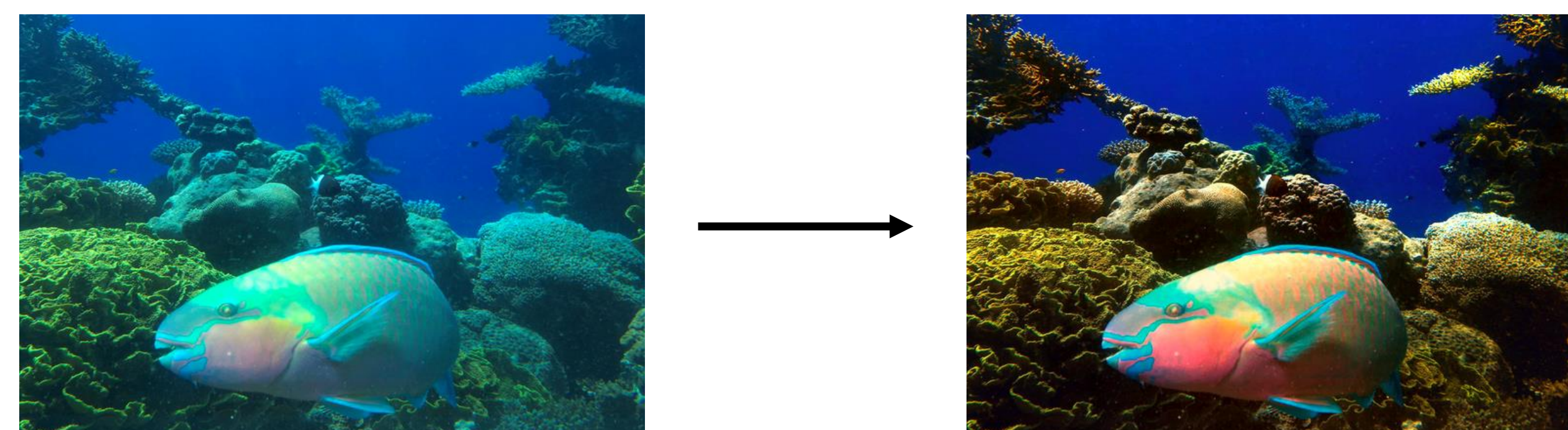
- ❑ Design Space Exploration : find trade-offs between schedulability (WCET) and energy for designs. *example of DSE options: lights, object recognition, DVFS*



- ❑ Use a multi objective optimization tool (PAES) coupled with an architecture simulator (Cheddar) for DSE of tasks scheduling

4 – Payload: image processing

- ❑ Underwater images are highly degraded
- ❑ Underwater vehicles need sight for auto positioning
- ❑ Five algorithms for underwater image restoration are compared and the best one is optimized
- ❑ Minimal execution time for real time applications



The general procedure of objects visibility enhancement process

- ❑ Implementation of 360° VR view in real time

The ROV-OPERATE project is funded by the ANR « Investissements d'Avenir: France 2030 » number ANR-19-GURE-0001 in the framework of the ERASMUS + SEA UE consortium

'BEING SEA-EU' 10-12 June 2024