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

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1- Department of Professional Studies/University of Split, Croatia, ✉ marko.vuksic@oss.unist.hr
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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

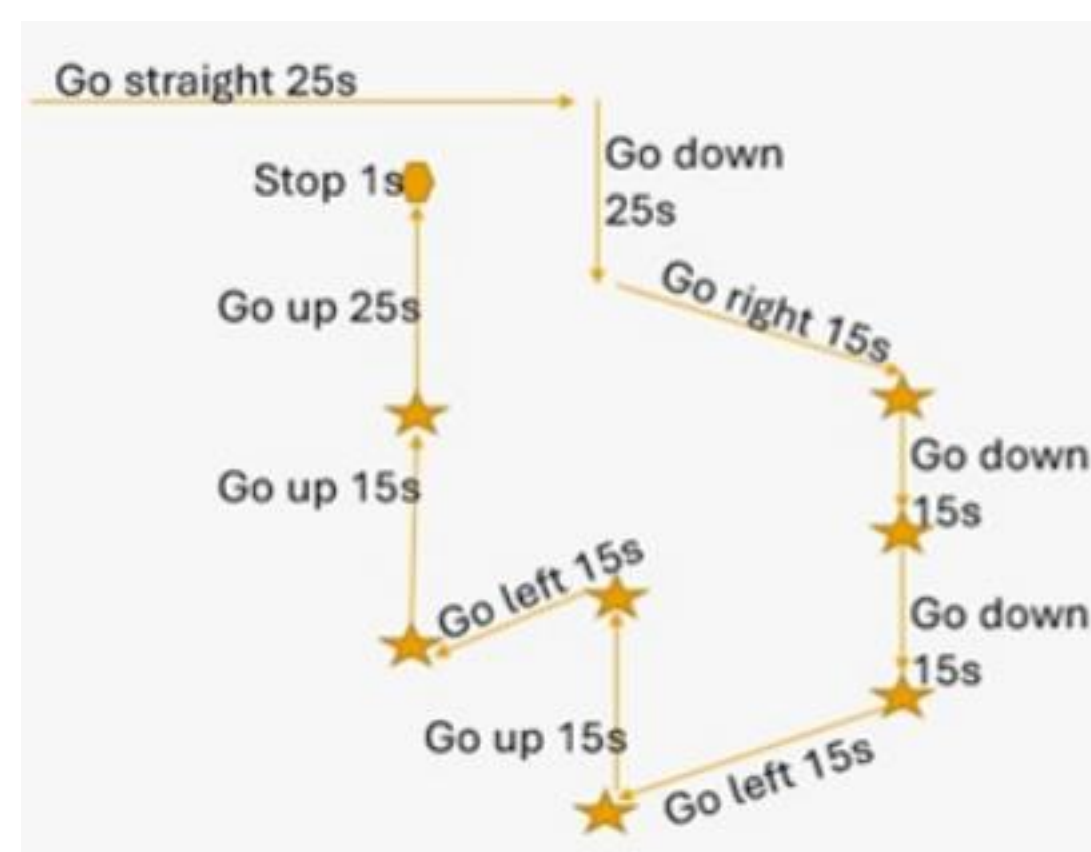❑ Completely autonomous system (without cable)
❑ Battery powered - 2 x 625 Wh 36VDC
❑ Central control unit - ARK-1551-S6A1
❑ Dive control autopilot - Pixhawk 6X
❑ Surface control system - computer, joystick, tether interface and screen
❑ Advanced communication to surface – Visible Light Communication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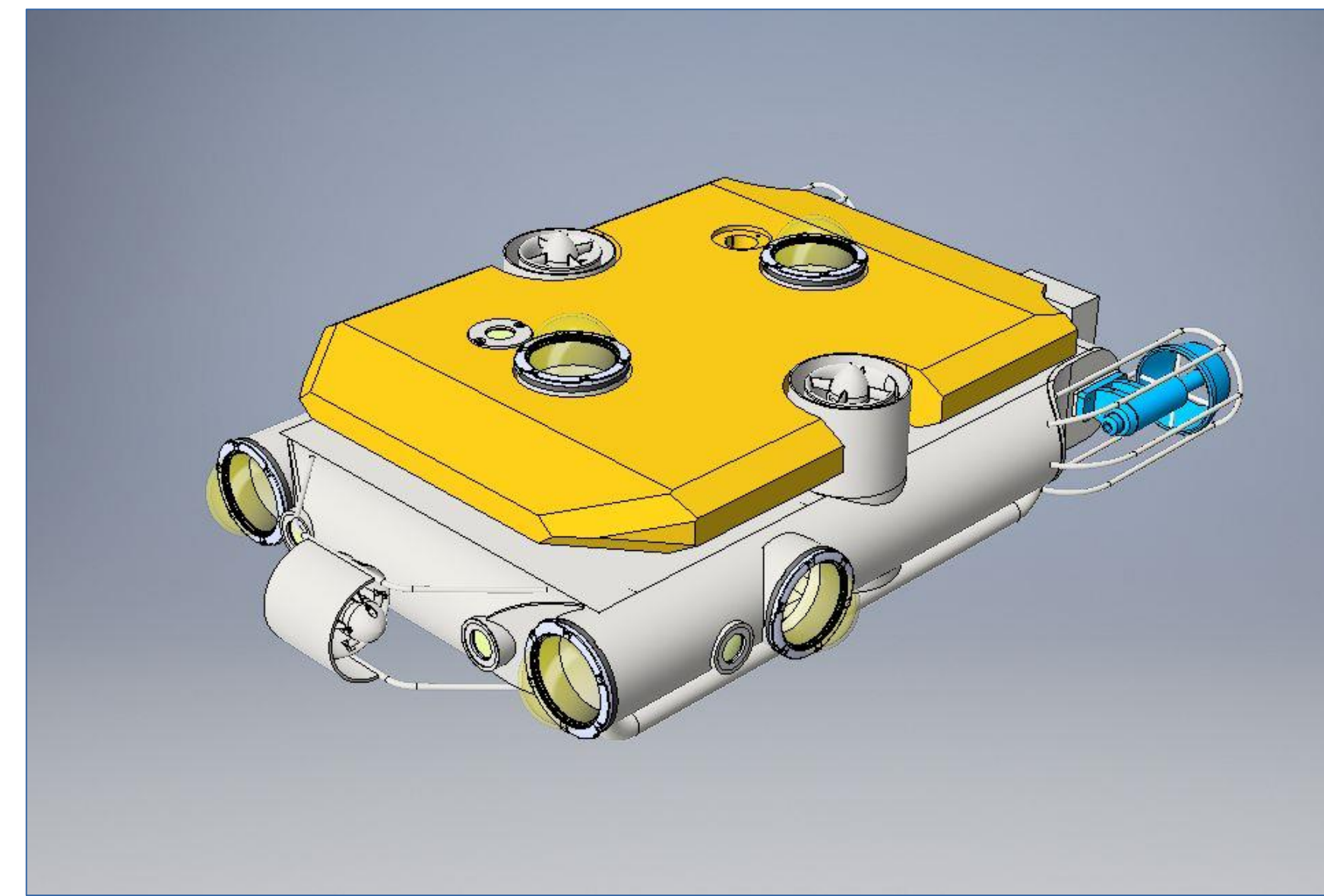
3 – Optimizing energy footprint

❑ 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
down2	Scheduling		ad1	15	25	127		

Go straight 25s
Stop 1s
Go up 25s
Go up 15s
Go left 15s
Go up 15s
Go left 15s
Go down 25s
Go right 15s
Go down 15s
Go down 15s

❑ Design Space Exploration : find trade-offs between schedulability (WCET) and energy for designs. *example of DSE options:* lights, object recognition, DVFS
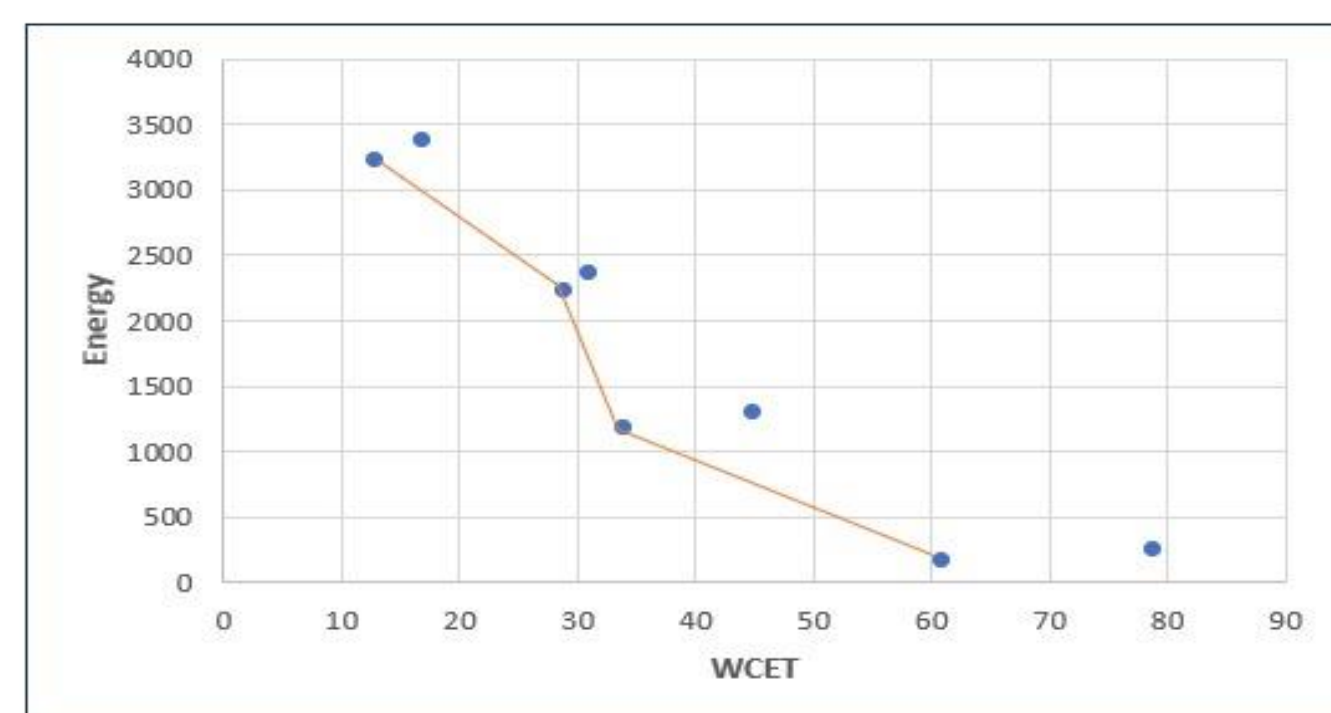
❑ Use a multi objective optimization tool (PAES) coupled with an architecture simulator (Cheddar) for DSE of tasks scheduling

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
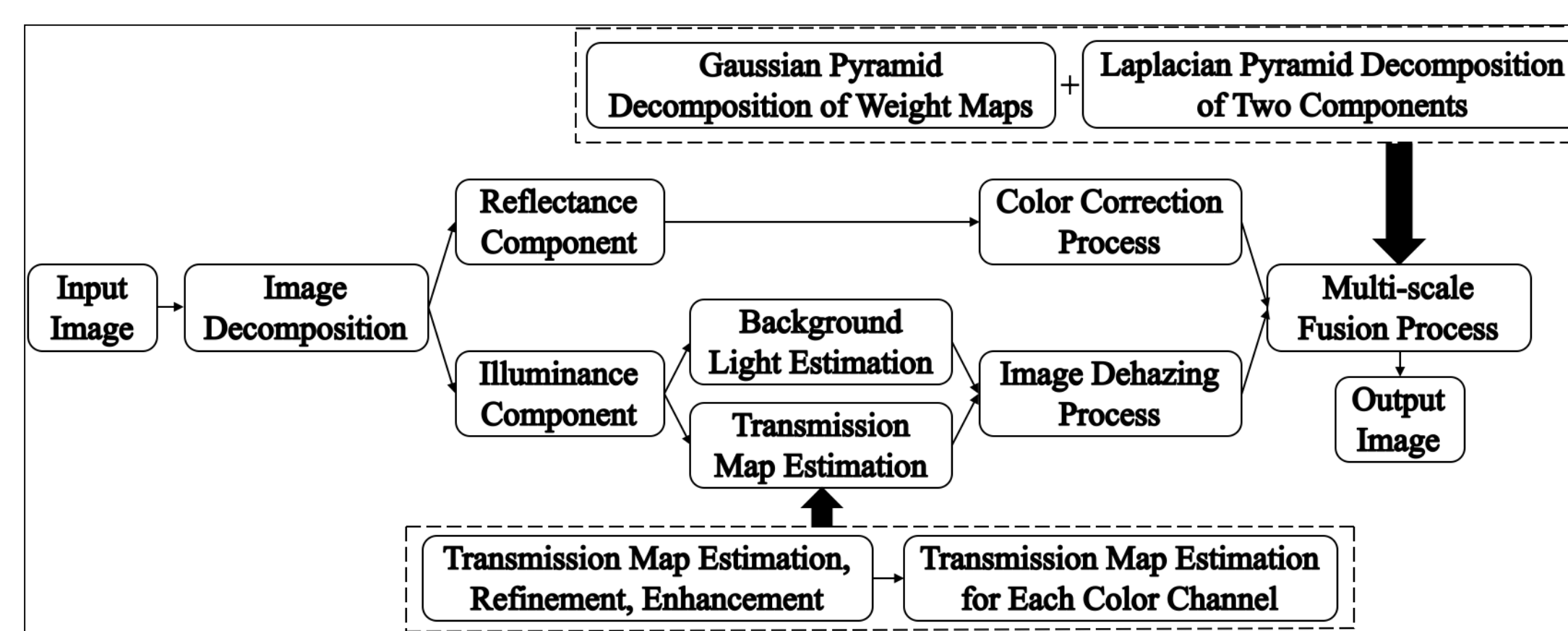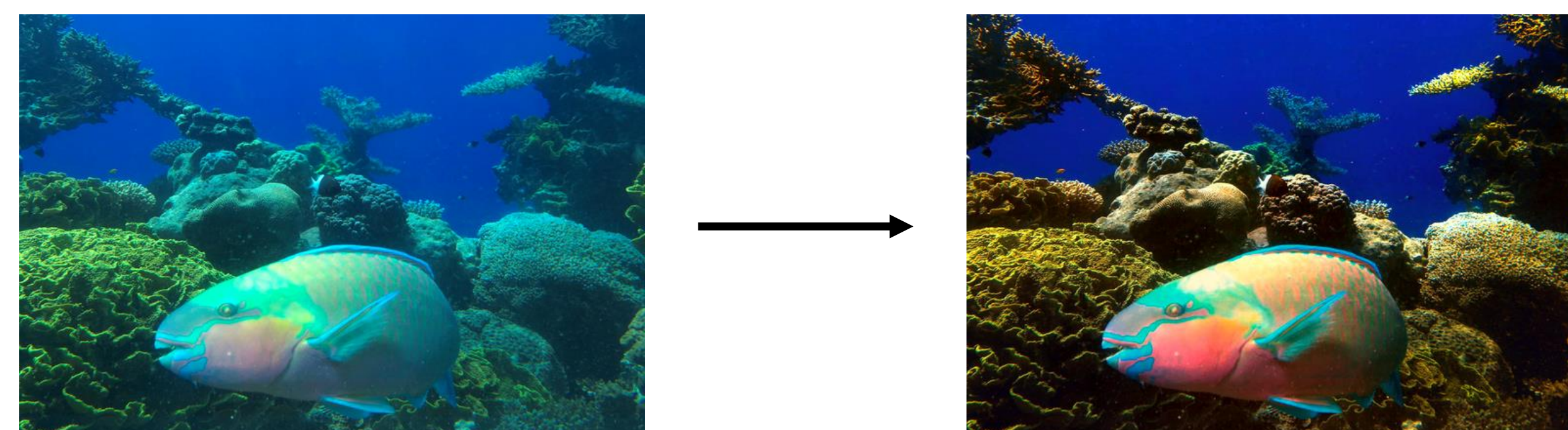
The general procedure of objects visibility enhancement process

❑ Implementation of 360° VR view in real time

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