Plenary Panel 1

David A. Mindell

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Massachusetts Institute of Technology

"They [Voyager spacecraft] were something more than dumb machines, because they had a degree of autonomy and had to act, within limits, independently of their handlers. They were more than simple ganglia of instruments, because they carried their own motive power, which granted them the means to journey. Like any artifact of human contrivance, *they exhibited a style that embodied the imagination and values of their creators, which granted them a simulacrum of personality*. They could be anthropomorphized in ways that the Santa Maria or the HMS Resolution could not, yet they were far from human, or even alive. In sailing beyond the realm of previous exploration, they also journeyed beyond the realm of expectation about how discovery might be done and *what constituted an explorer*."

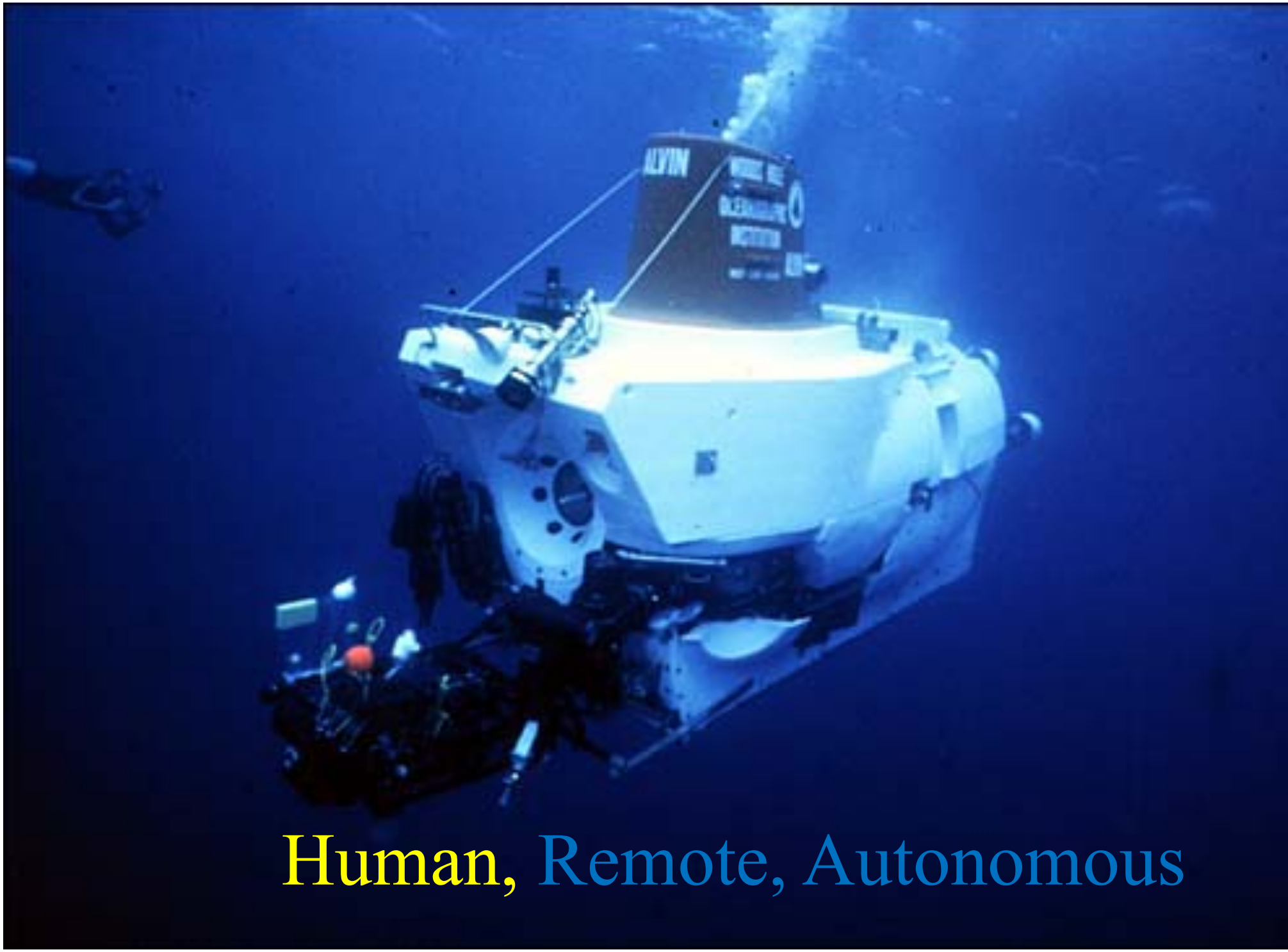
Stephen Pyne, Voyager: Exploration, Space, and the Third Great Age of Discovery (emphasis added)

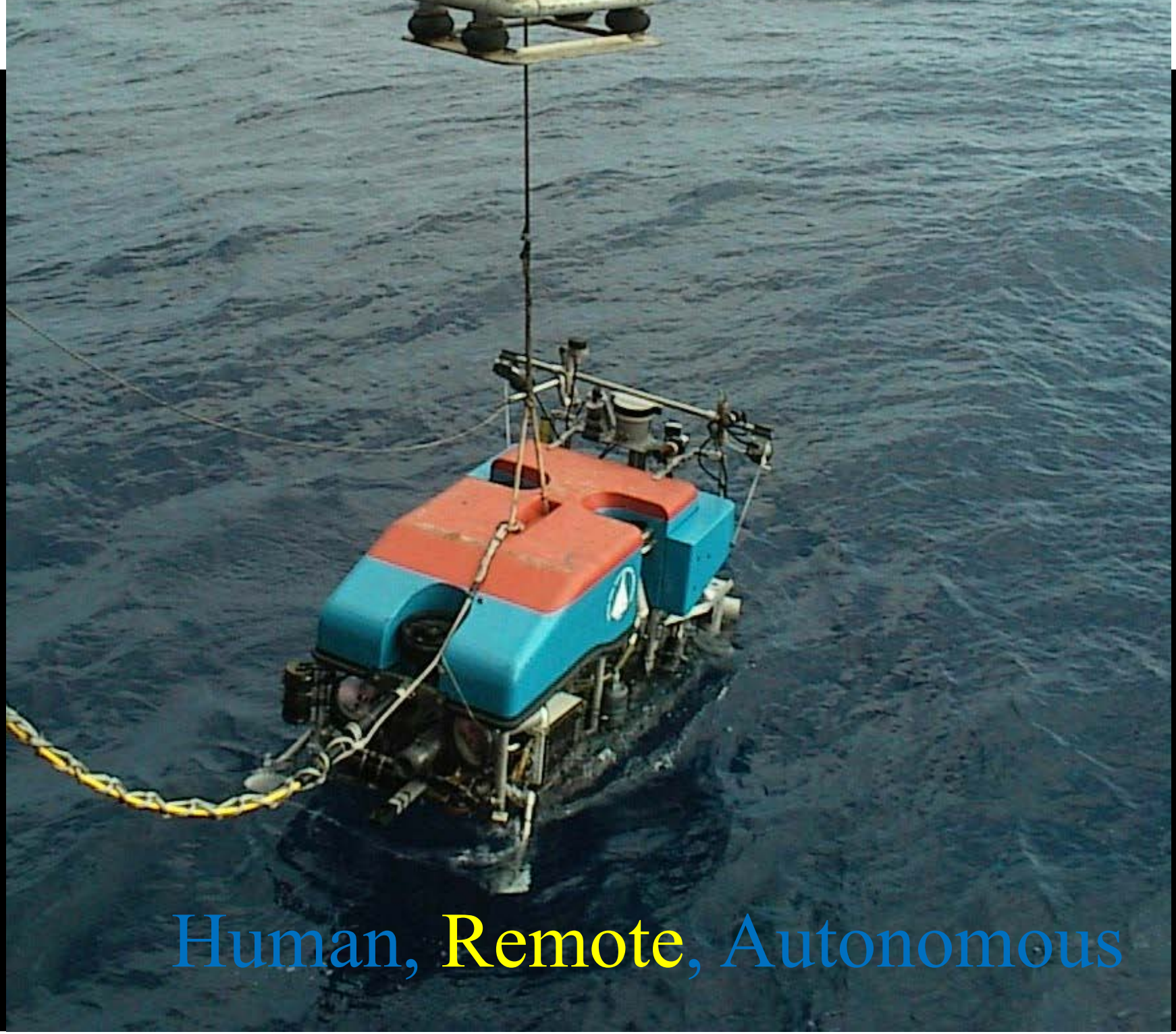
"The MER exploration system constitutes a blended scientific practice: *exploring scientifically*, engaging in *field and laboratory* work by interweaving *human and robotic* operations, using a textbook method (*being systematic*) yet stopping to investigate interesting features (*being opportunistic)* and probing the landscape in a *kinesthetic, imagined experience*."

William J. Clancey, Voyages of Scientific Discovery with the Mars Exploration Rovers (MIT Press, forthcoming) (emphasis original)

Not "present vs. not present," but *different forms* of human presence

- At what time(s)?
- From what place?
- Doing what? (e.g. what scientific practice?)
- By whom?
- Through what bandwidth/time delays?
- Where are the bodies? What is at stake?
- What constitutes presence?

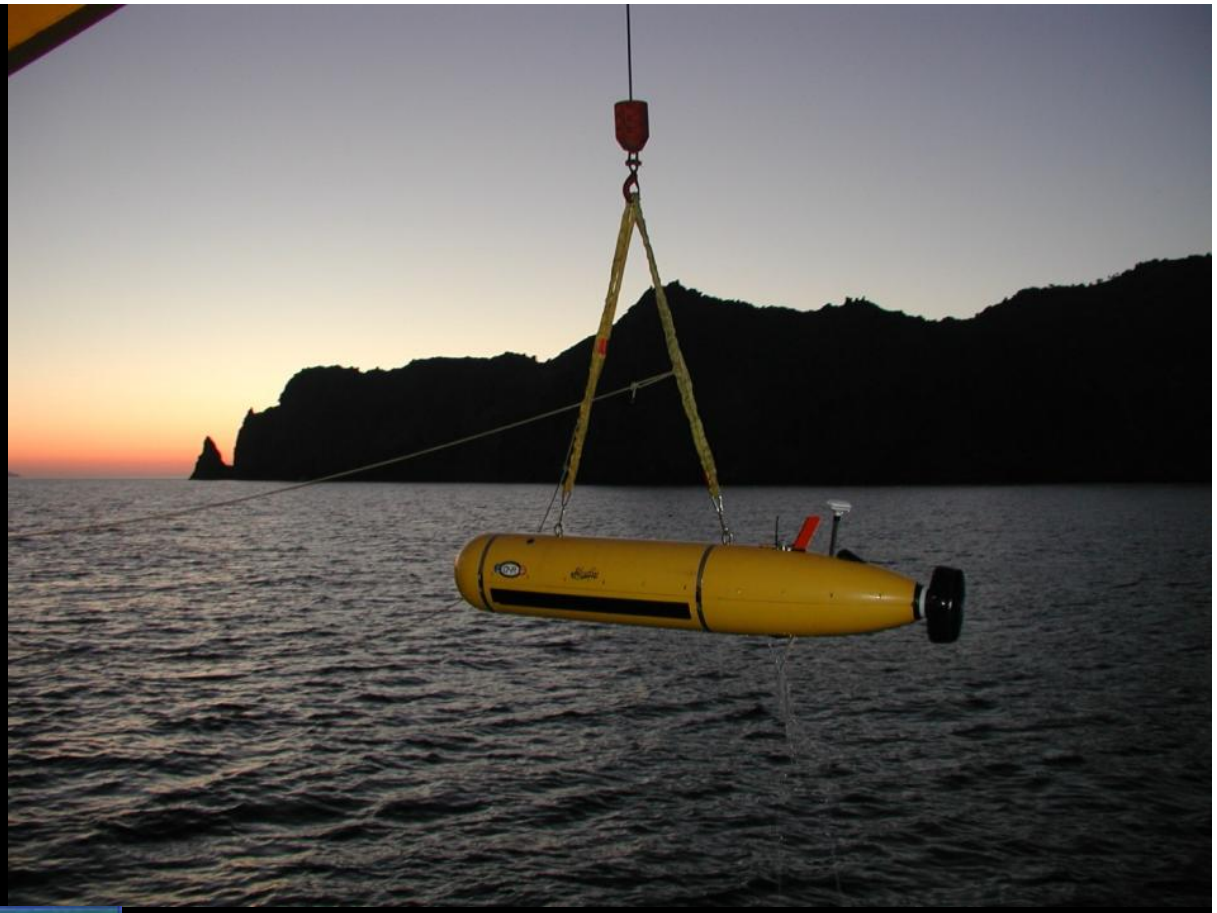

ALVIN
Human, Remote, Autonomous

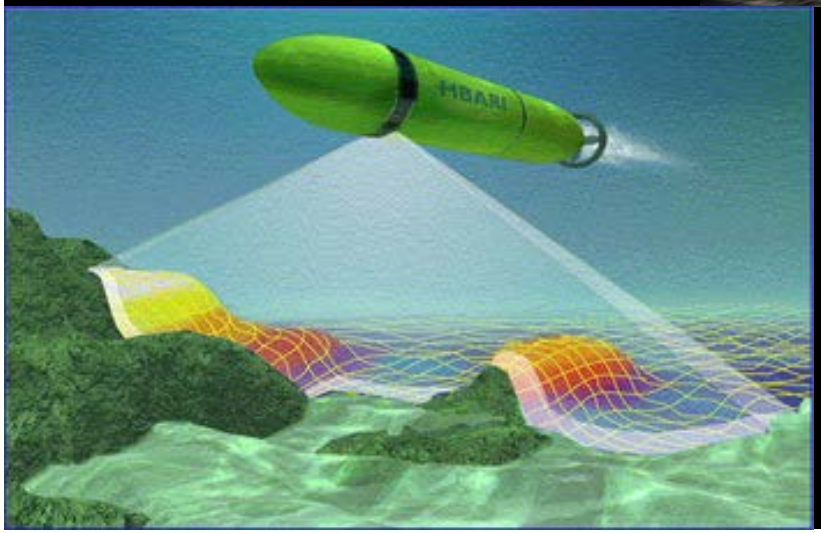

Human, Remote, Autonomous

Human,

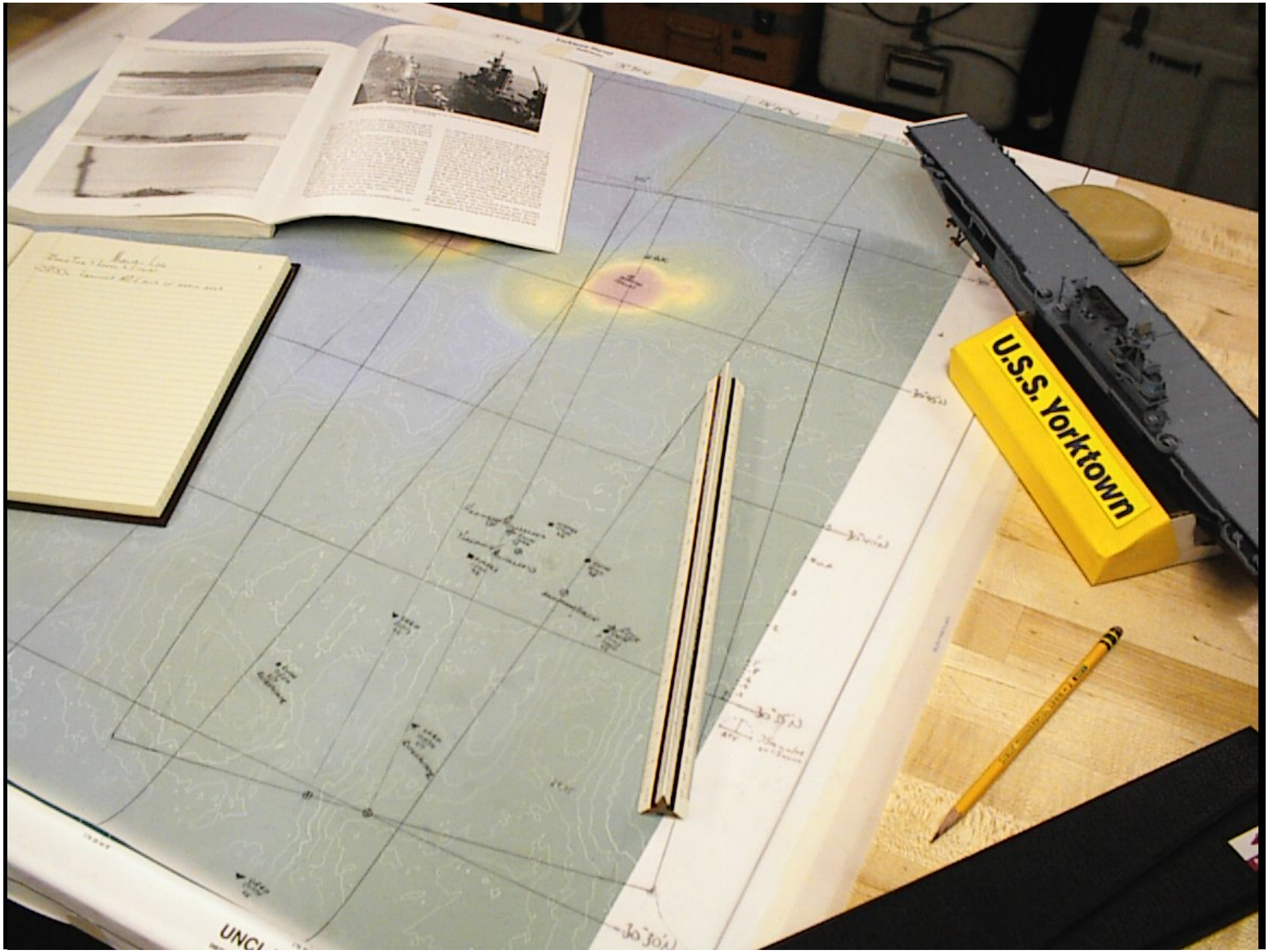
Remote,

Autonomous



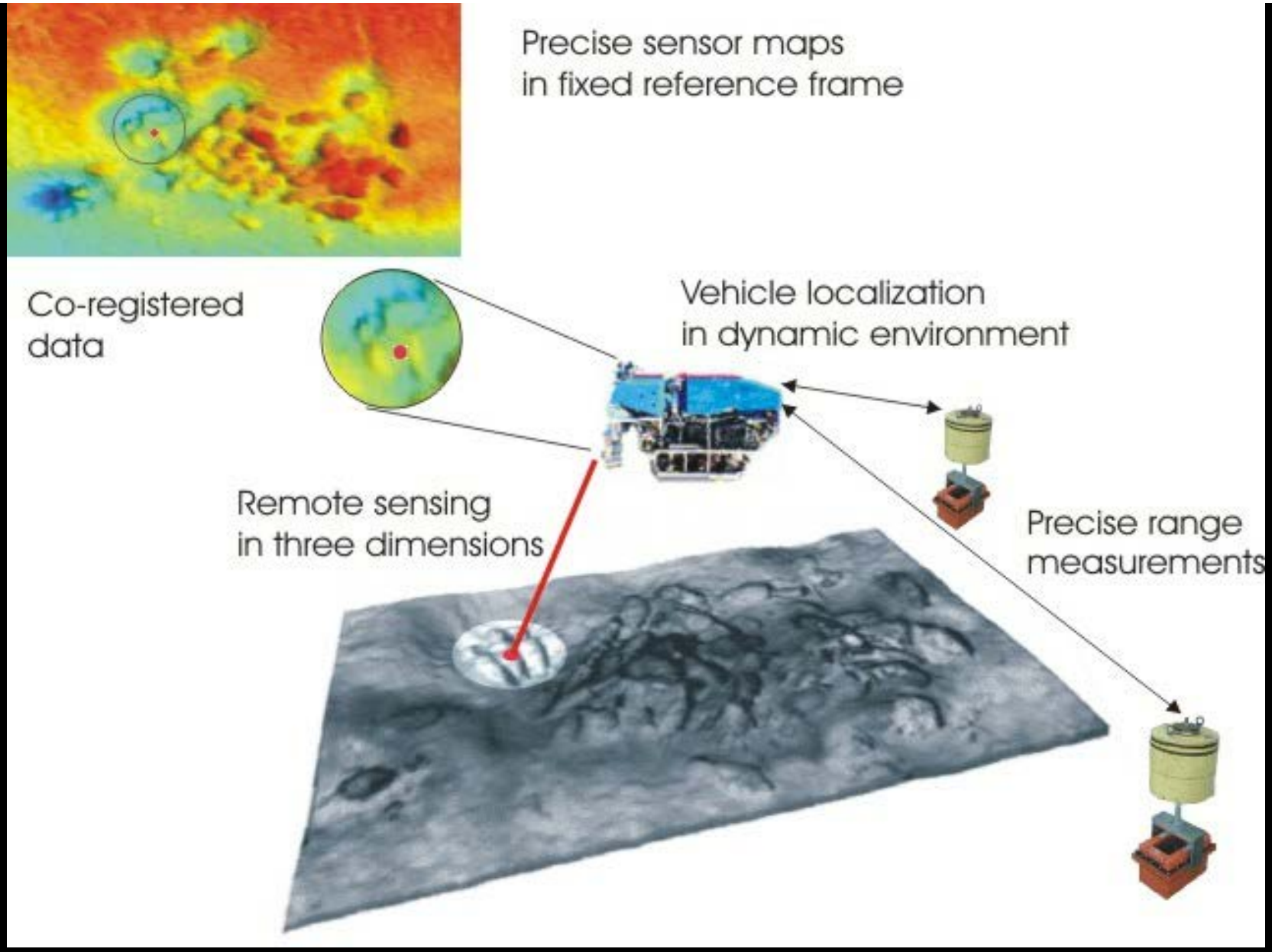


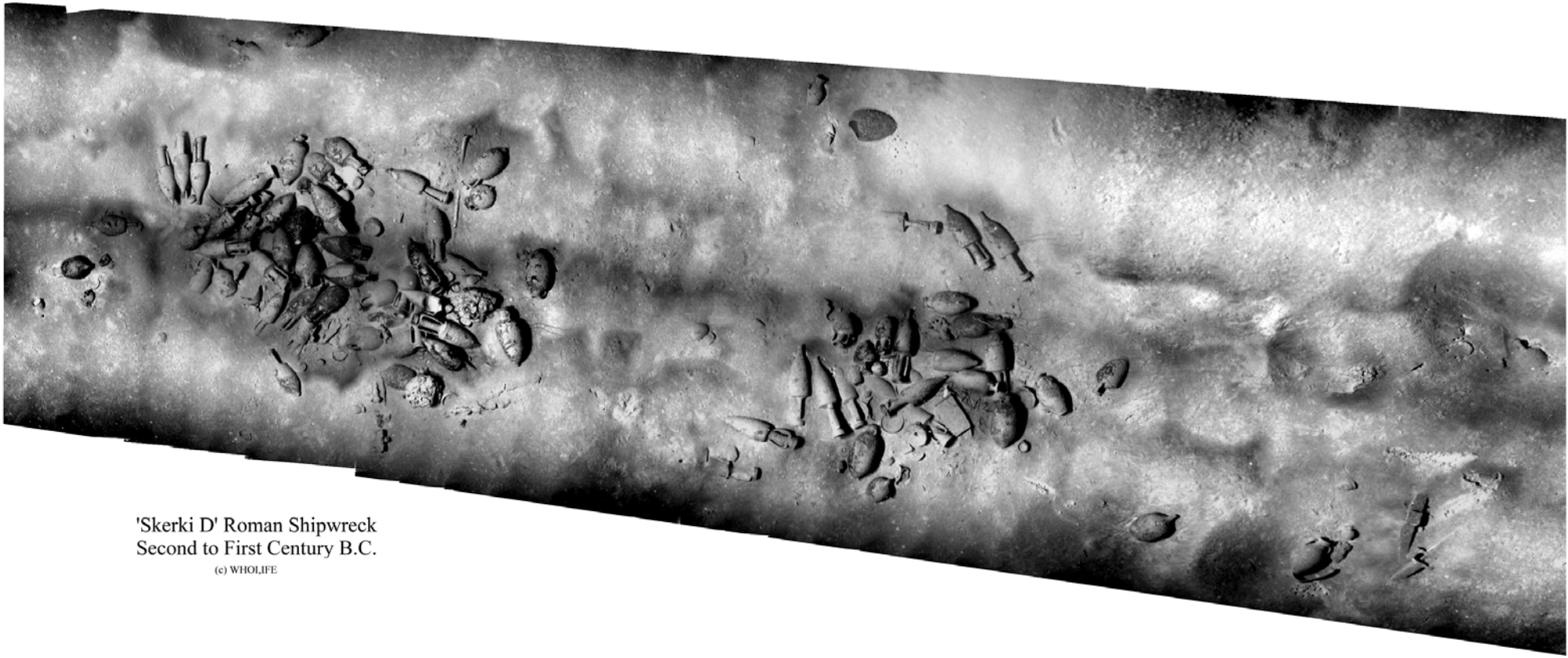
INSTITUTE FOR AEROSPACE


U.S.S. Yorktown

U.S. Navy Nuclear Research Submarine

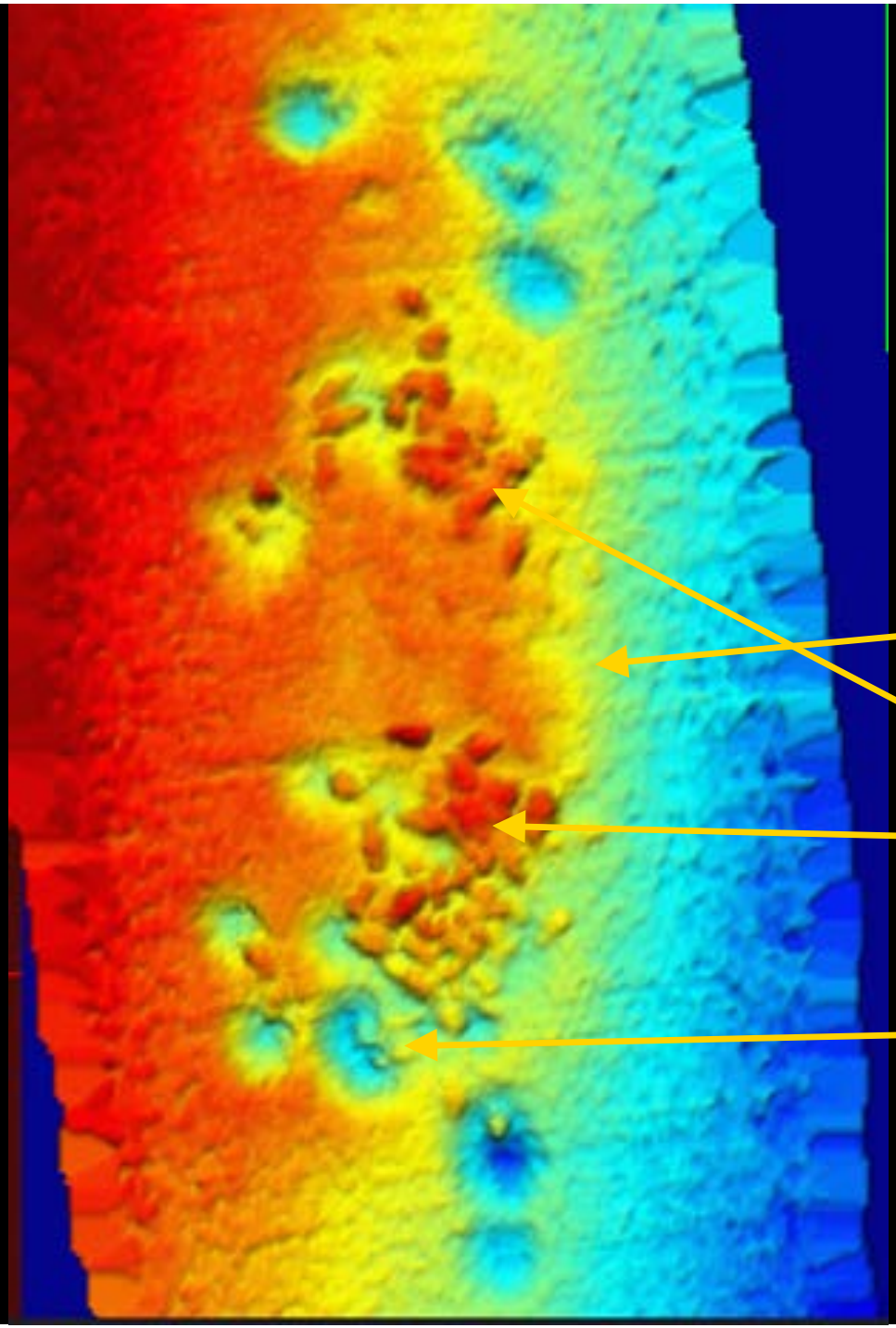
NR1


Precise sensor maps
in fixed reference frame
Co-registered
data
Vehicle localization
in dynamic environment
Remote sensing
in three dimensions
Precise range
measurements



'Skerki D' Roman Shipwreck
Second to First Century B.C.

(c) WHOI,IFE



Precision mapping of seafloor sites "microbathymetry"

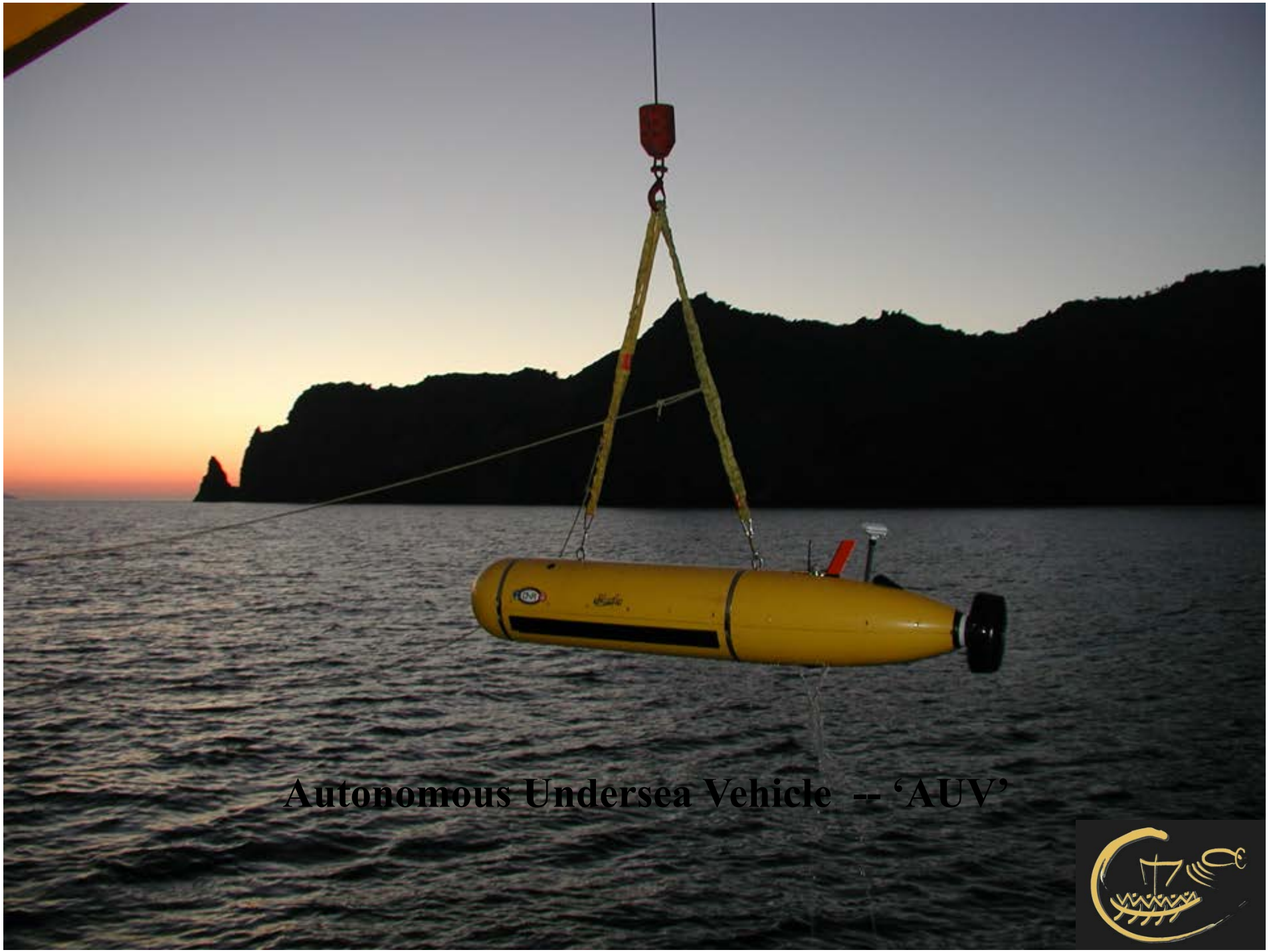
Hull outline

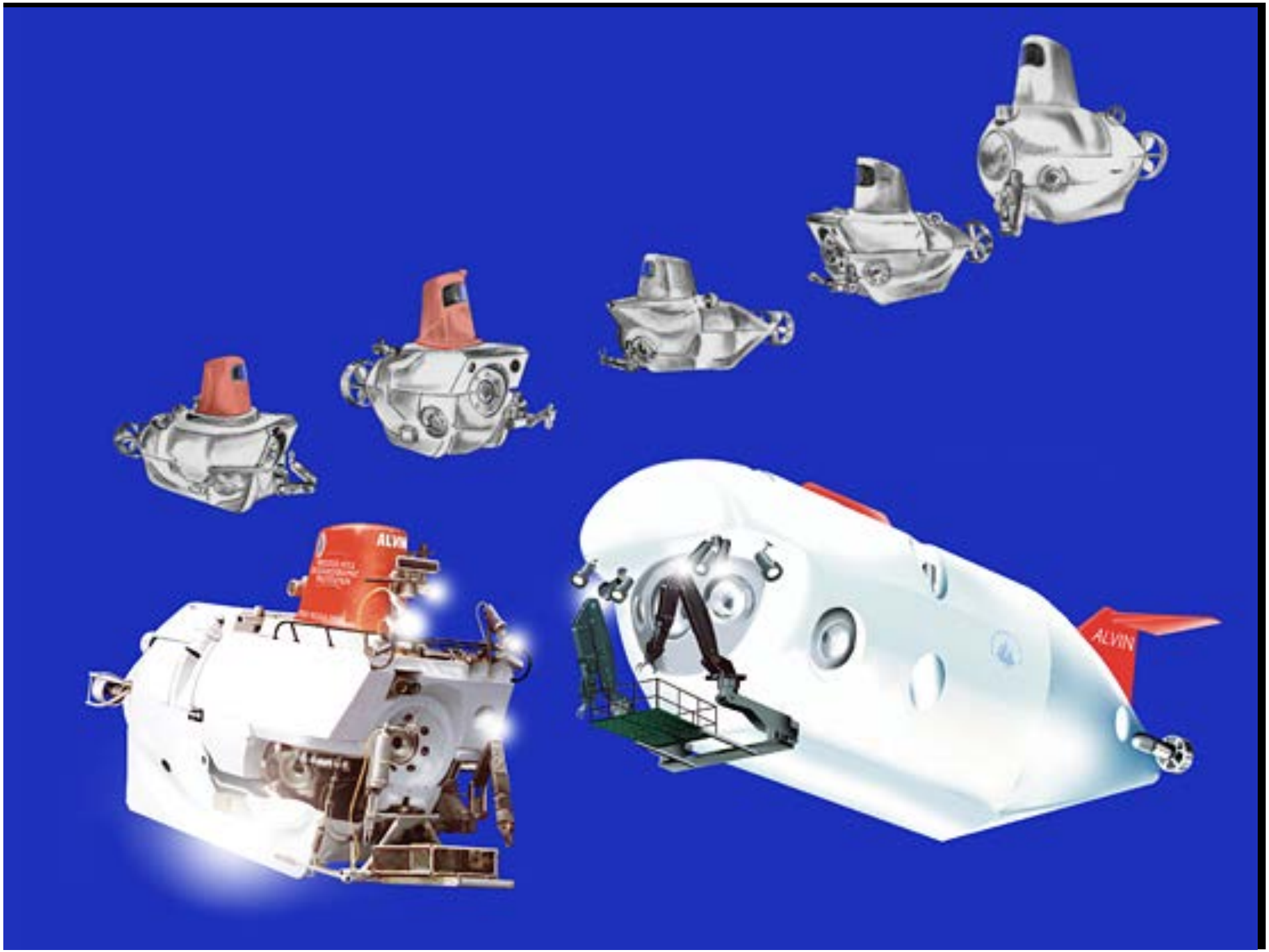
Amphora

Amphora

(Ballard, et. al., 2000)

craters


Autonomous Undersea Vehicle -- 'AUV'


ALVIN
ALVIN

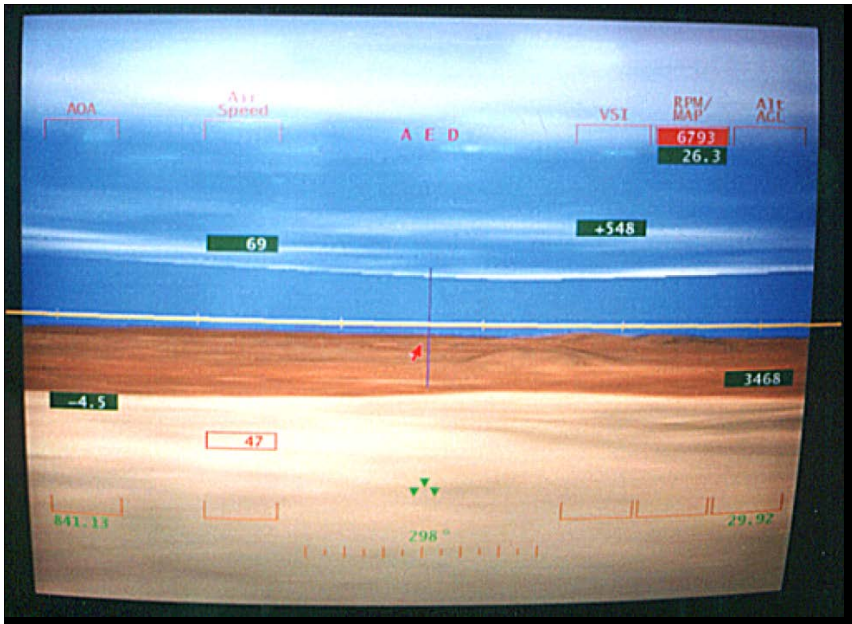
The MQ-9 Reaper Remotely Piloted AIRCRAFT (RPA): Humans and Machines in action

MIT Dissertation, Aug. '11

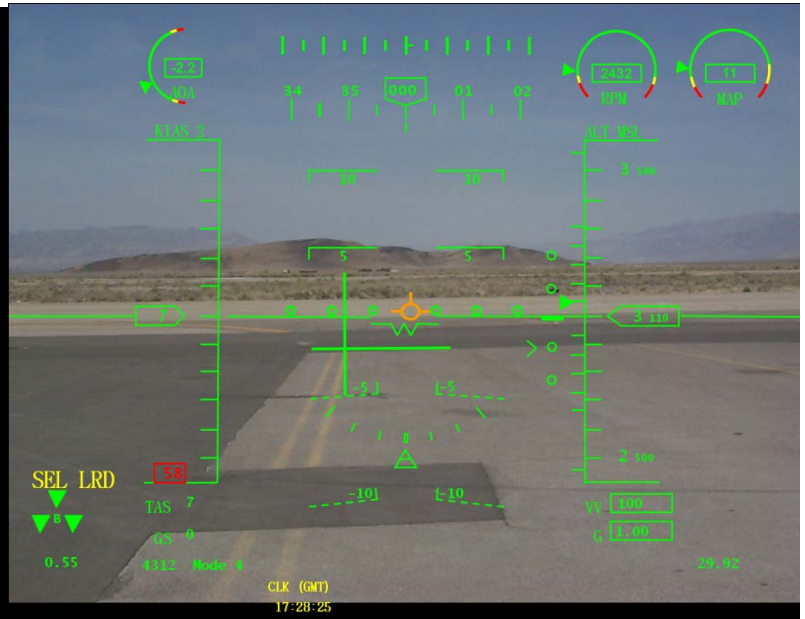
Tim Cullen, Lt Col, US Air Force

MIT Laboratory for

Automation, Robotics, and Societyty



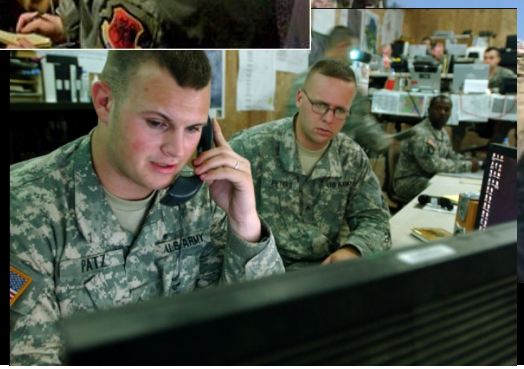
“Legacy” HUD

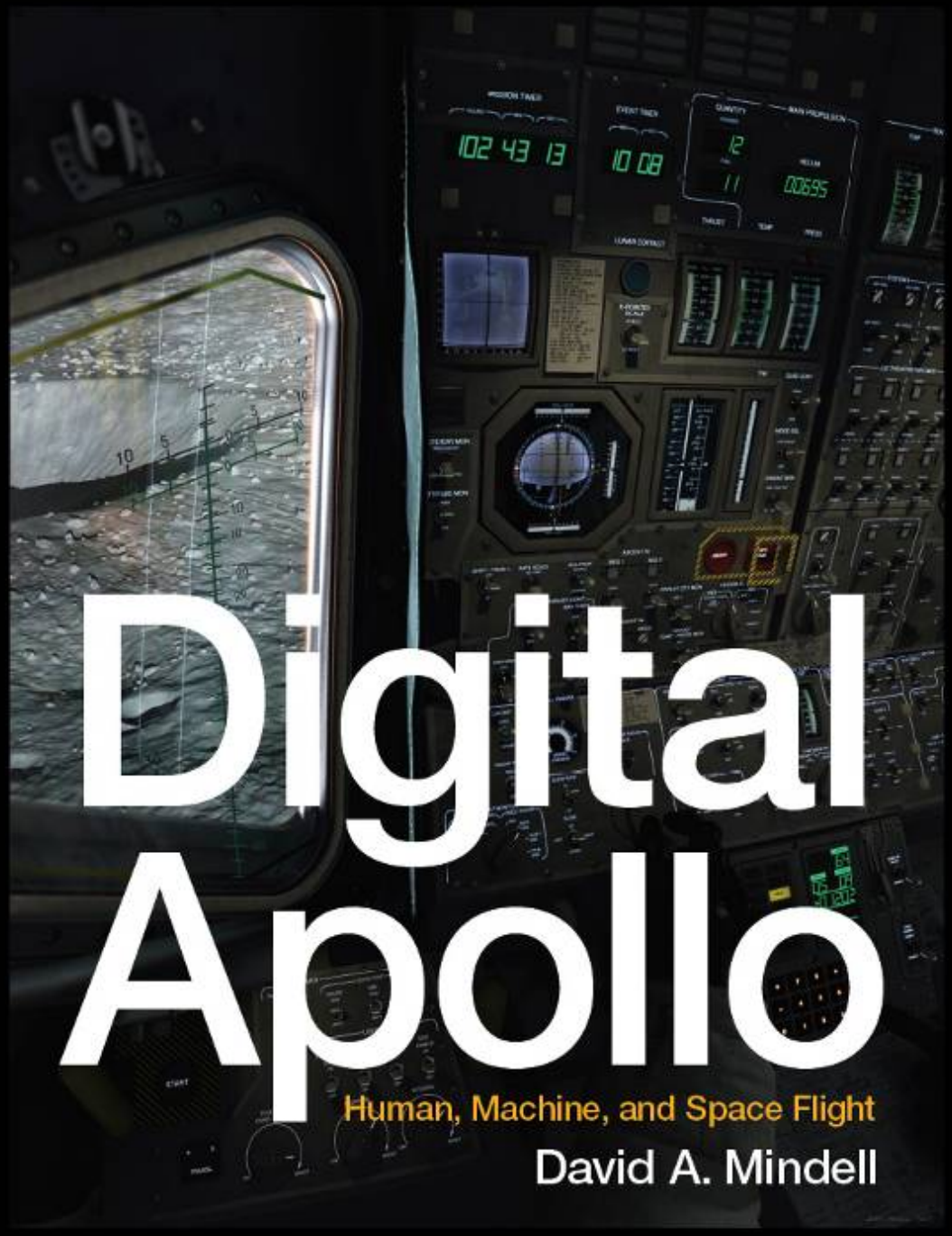


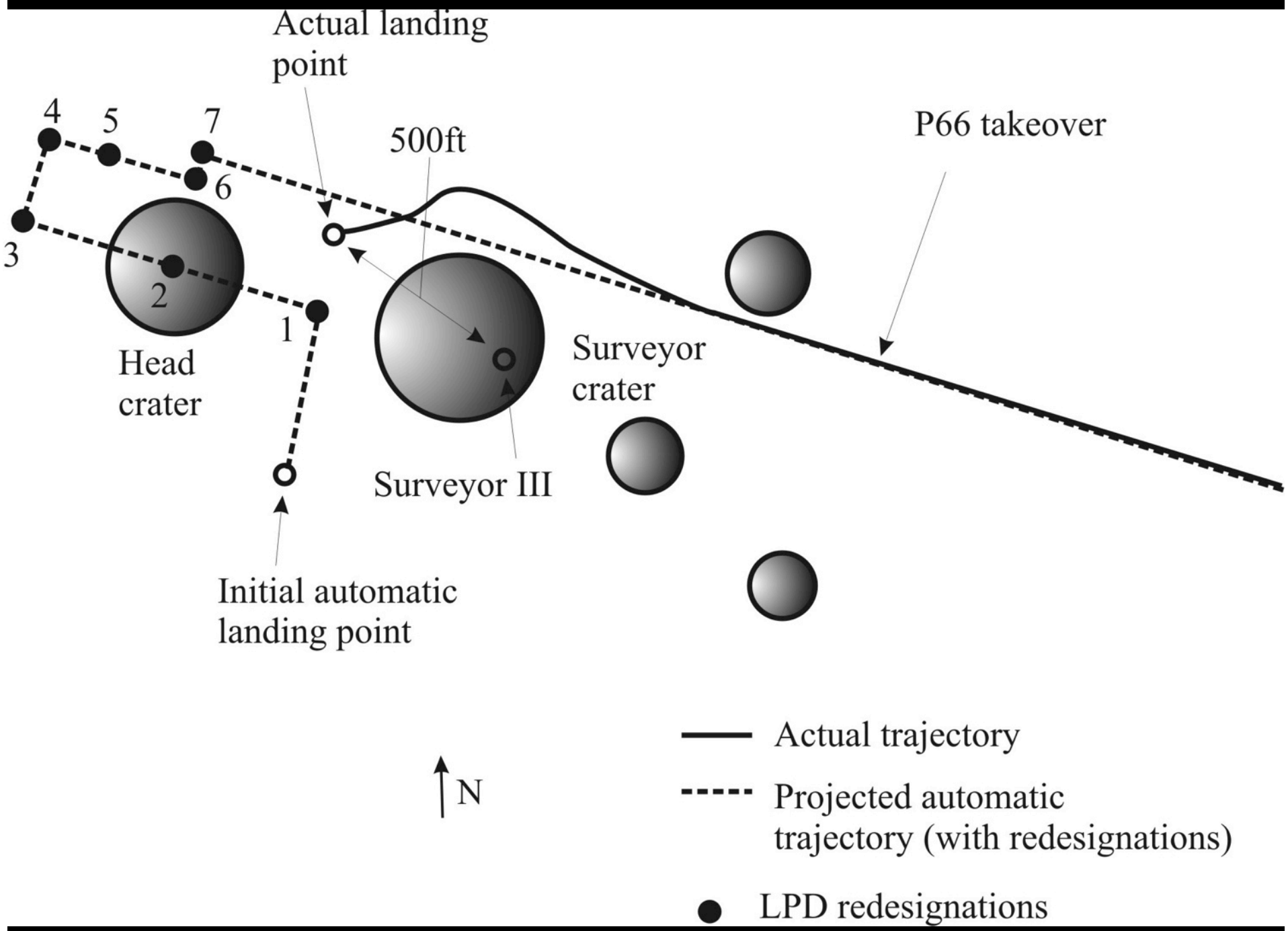
“Improved” HUD

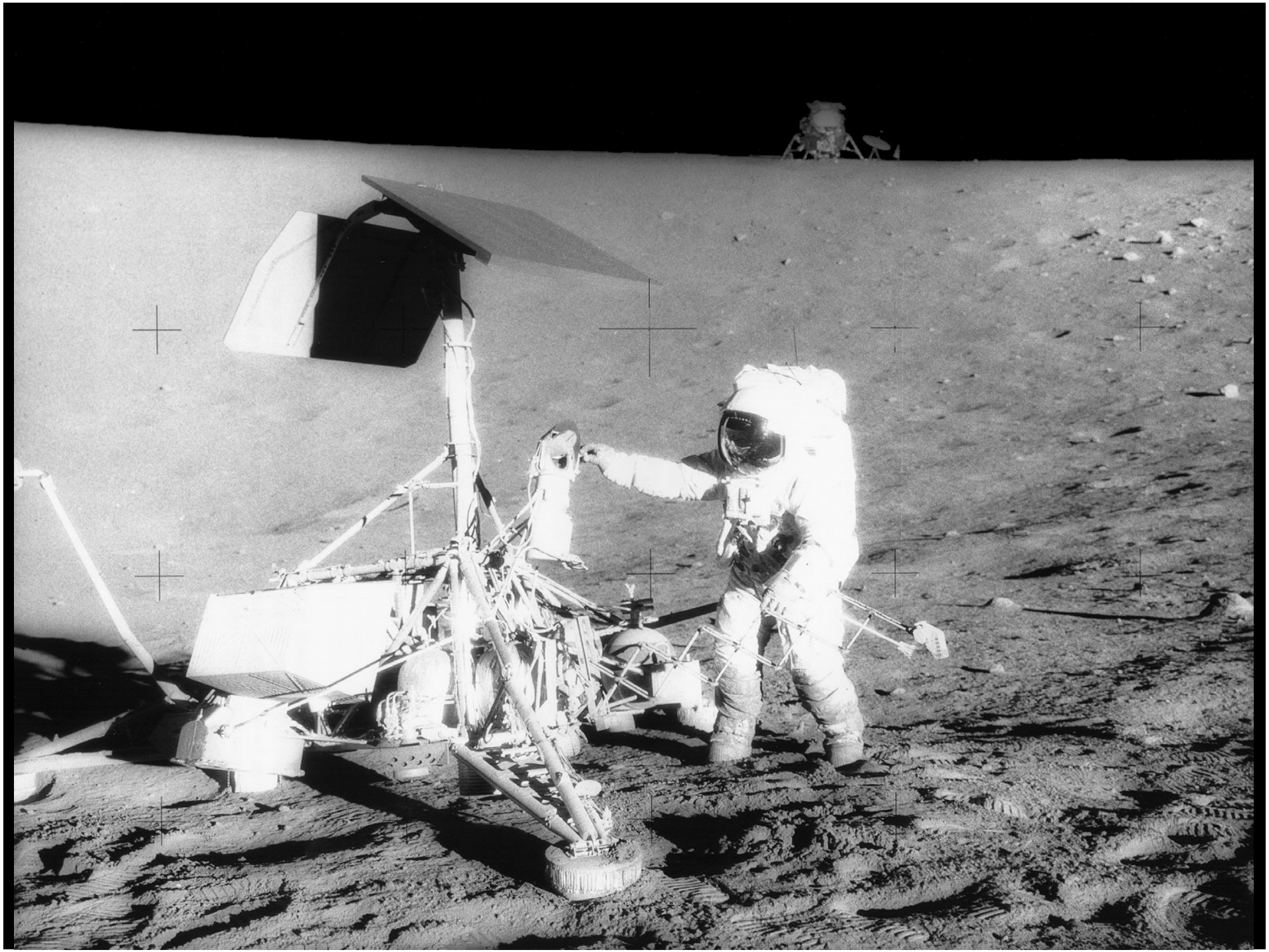
“Advanced” HUD

Reaper Crew: “Building a Picture”




Digital
Apollo
Human, Machine, and Space Flight
David A. Mindell


Actual landing point
4
5
7
6
3
2
1
500ft
P66 takeover
Head crater
Surveyor crater
Surveyor III
Initial automatic landing point
N
Actual trajectory
Projected automatic trajectory (with redesignations)
LPD redesignations



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