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Ocean *Zooglider*: an autonomous vehicle for optical and acoustic sensing of zooplankton and suspended particles

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Zooglider is an autonomous buoyancy-driven ocean glider designed and built by the Instrument Development Group at Scripps. *Zooglider* includes a low power camera with a telecentric lens for shadowgraph imaging and two custom active acoustics echosounders (operated at 200/1000 kHz). A passive acoustic hydrophone records vocalizations from marine mammals, fishes, and ambient noise. The imaging system (*Zoocam*) quantifies zooplankton and 'marine snow' as they flow through a sampling tunnel within a well-defined sampling volume. Other sensors include a pumped Conductivity-Temperature-Depth probe and Chl-*a* fluorometer. An acoustic altimeter permits autonomous navigation across regions of abrupt seafloor topography, including submarine canyons and seamounts. Vertical sampling resolution is typically 5 cm, maximum operating depth is ~500 m, and mission duration up to 50 days. Adaptive sampling is enabled by telemetry of measurements at each surfacing. Our post-deployment processing methodology classifies the optical images using advanced Deep Learning methods that utilize context metadata. *Zooglider* permits in situ measurements of mesozooplankton and marine snow - and their natural, three dimensional orientation - in relation to other biotic and physical properties of the ocean water column. *Zooglider* resolves micro-scale patches, which are important for predator-prey interactions and biogeochemical cycling.