

Simulated SAS Data Package

Overview:

The purpose of this data package is to provide a small set of simulated synthetic aperture sonar (SAS) data for public use. Included in this data package is simulated sonar data in Generic Data Format (GDF) files, a description of the GDF file contents, example SAS imagery, and supporting information about the simulated scenes.

Data description:

This dataset contains 10 SAS scenes of data which include a seafloor with a relief texture on the horizontal plane and 9 objects in each scene. The 9 objects in each scene include: 3 lobster traps, 3 rocks, and 3 cylinders. These objects are introduced at different locations and poses in each scene. In addition, one scene, labeled scene 0, contains isolated point scatterers in the horizontal plane (without a relief texture). The purpose of scene 0 is to allow for testing of a beamformer's image reconstruction capabilities and observation of the point spread function in isolation. The scatterer locations for scene00 are listed in "Scatterer_Locations_Scene00.csv." All scenes are 60 m along-track by 90 m cross-track. The time series data is provided without noise so that the user can employ their own noise model. The sonar vehicle travels a linear, ideal path. Figures are also provided which show the placement of objects within each scene. The object locations are listed in "Object_Locations_All_Scenes.csv." Each 60 m x 90 m scene is represented by 4 raw (not beamformed) GDF files. It is possible to beamform smaller scenes from any one of these 4 files.

GDF files are written in a binary data format described in the file "GDF_Interface_Control_Document.pdf." All of the data needed to construct a SAS image is contained within these GDF files. This includes sensor locations, including element position, navigation data, transmit signal waveform and characteristics, and time series data.

Sample images are included that were generated using the Advanced Synthetic Aperture Imaging eNgin (ASASIN) [Gerg et al. 2020]. The sample images are provided in the tif image format. The image data shown in the tif files have an amplitude compression applied that prepares the data for human-eye consumption. The pixel size in these images is 2.5 by 2.5 cm. In addition, a science file containing the single-look complex (SLC, science file) data is provided and stored in the Hierarchical Data Format 5 (<https://www.hdfgroup.org/>). It is appended with ".hdf5" to indicate the HDF5 format. This data product is sample based, i.e. not an image.

The simulation data was generated using PoSSM [Johnson and Brown 2018]. Object responses were generated using the TriKirch method [Abawi 2016]. The "Bellettini SAS" sonar geometry is based on a paper in the SAS literature [Bellettini and Pinto 2008]. The sonar system has a single transmitter and 36 hydrophones in a linear array. The transmit signal is a 60 kHz bandwidth linear frequency modulated (LFM) upswep 4 ms pulse centered at 300 kHz. The simulated transmitter and hydrophone beam patterns are Gaussian, with a 3-dB beamwidth equivalent to that of a rectangular element's sinc pattern of the same physical size. The horizontal and vertical dimensions of the sensors are 5 cm by 1.92 cm for the transmitter and 3.33 cm by 1.39 cm for the hydrophones.

References:

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Bellettini, Andrea, and Marc Pinto. "Design and experimental results of a 300-kHz synthetic aperture sonar optimized for shallow-water operations." *IEEE Journal of oceanic engineering* 34, no. 3 (2008): 285-293.

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Johnson, Shawn F., and Daniel C. Brown. "SAS simulations with procedural texture and the point-based sonar scattering model." In *OCEANS 2018 MTS/IEEE Charleston*, pp. 1-7. IEEE, 2018.