SEA-Shock Overview

SEA-Shock

SEA-Shock is an **optional module of SEA+ software.**

SEA-Shock has been designed to successfully predict **S**hock **R**esponse **S**pectra (**SRS**) from transient loads applied to **S**tatistical **E**nergy **A**nalysis (**SEA**) models of dynamical systems. For aerospace applications, SEA-Shock includes source models for pyrozip and clampband separation events.

SEA-Shock is a reference method for predicting SRS described in the Shock Handbook of the European Space Agency (ESA).

Some of the Features and Benefits of SEA-Shock are:

Broadband SRS generation

SEA-Shock generates SRS and time history responses from an SEA+ model of the system.

Mean time history response

The dedicated **L**ocal **M**odal **P**hase **R**econstruction (**LMPR**) algorithm reconstructs modal phase information from a frequency band integrated spectra provided by the SEA model and from this delivers prediction of mean time histories in SEA subsystems.

Much more...

Source models of pyrozip separation and clampband, pulse generator to quickly build time history profiles of input forces …

It is a unique way of predicting shock response in the high frequency domain from combined **F**inite **E**lement **M**ethod (**FEM**) model and SEA+ 3D graphical user interface.

SEA-Shock Theory

SEA-Shock core technology is the implementation of techniques developed for aerospace pyrotechnical shock applications.

SRS computation is following the general French standard of GAM EG 13.

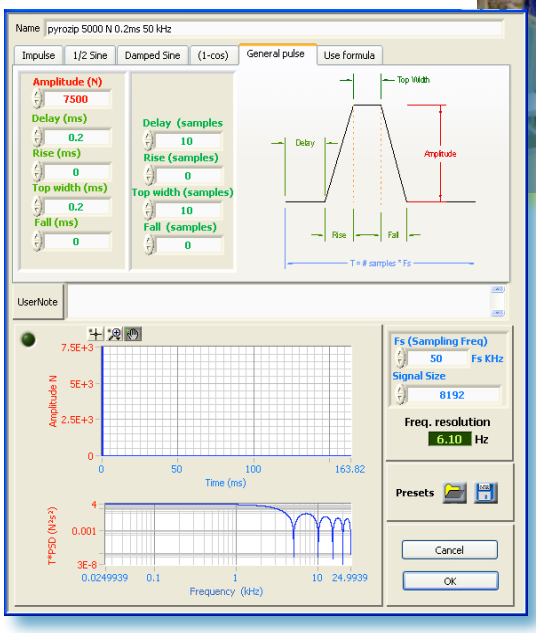
Shock Response Synthesis is a specific post-processing of an SEA model built with SEA+. The SEA model itself can be derived from FEM model using the **V**irtual **SEA** (**VSEA**) technology available in SEA+ and may be extended to very high frequency using analytical modeling of subsystem dynamic's. A typical SEA-Shock/ SEA+ model of a spacecraft may then provide time histories and SRS from 100 Hz up to 100 kHz, giving access to instantaneous acceleration peak levels impossible to predict with a classical FEM approach where bandwidth of output time histories is limited to 1 or 2 kHz.

Correction factors are available to take into account effect of non modal responses (direct field front wave propagation from source to receiver) and mass loading of the equipment on the supporting structures.

To retrieve a time domain evolution from the amplitude spectrum, Shock Response Synthesis is using the LMPR algorithm. This algorithm artificially recreates modal phase information that is added to the real-valued amplitude of transfer functions predicted from the SEA model. This phase information is created with the internal library of subsystems of SEA+ which includes many possibilities for describing subsystem structural complexity such as sandwich and ribbed construction with tracking of orthotropy effects on the dynamical behavior.

Then, the final response of the receiver may be obtained as a convolution product between the user-defined force profile f(t) and the synthesized LMPR impulse response of transfer function between force and receiver.

Computing SRS up to 100 kHz is then achievable at low cost and extend in a natural way finite element computation only applicable in the low frequency domain.



SEA-Shock Specifications

Input data

- Force amplitude and shape in loaded subsystem
- Validated SEA+ model of the spacecraft

Predefined input force profiles

- half sinus
- saw tooth
- rectangular
- trapezoidal
- sinus verse
- damped sinus

Shock Output on a receiver subsystem

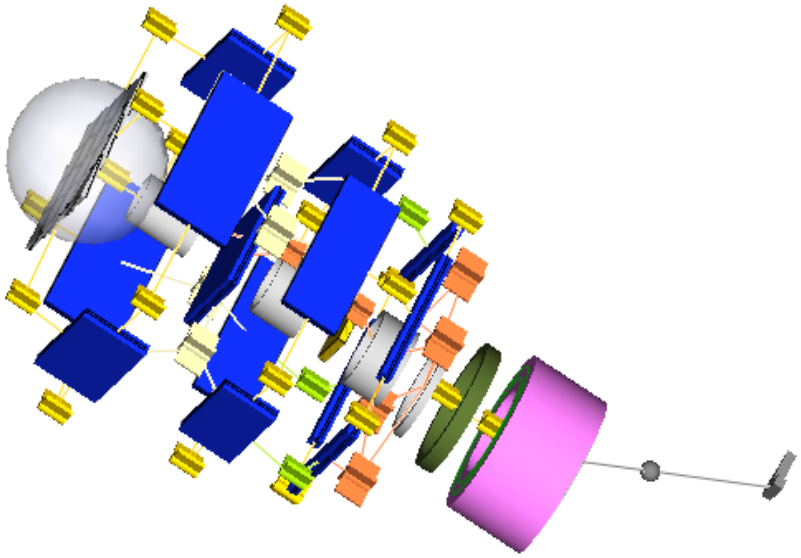
SRS and time histories are predicted for flexural, shear and extensional energies propagating in the system. SRS is computed as:

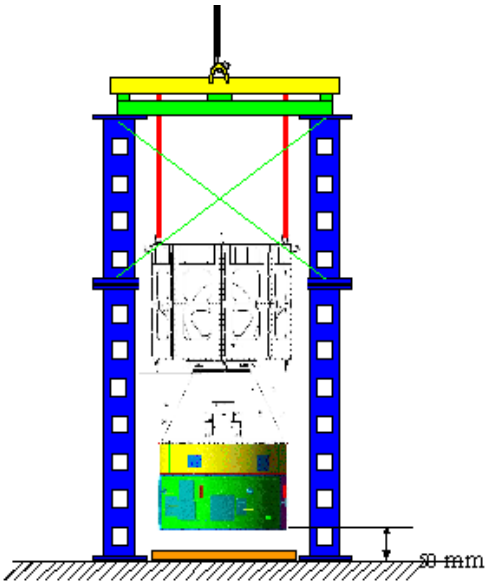
- Primary positive SRS
- Secondary positive SRS
- Maximax SRS

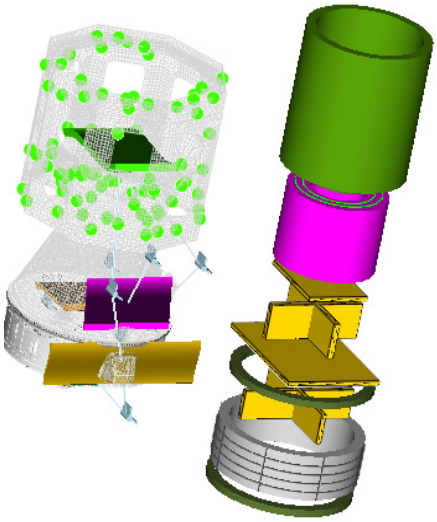
Variance of SRS within a subsystem is also provided.

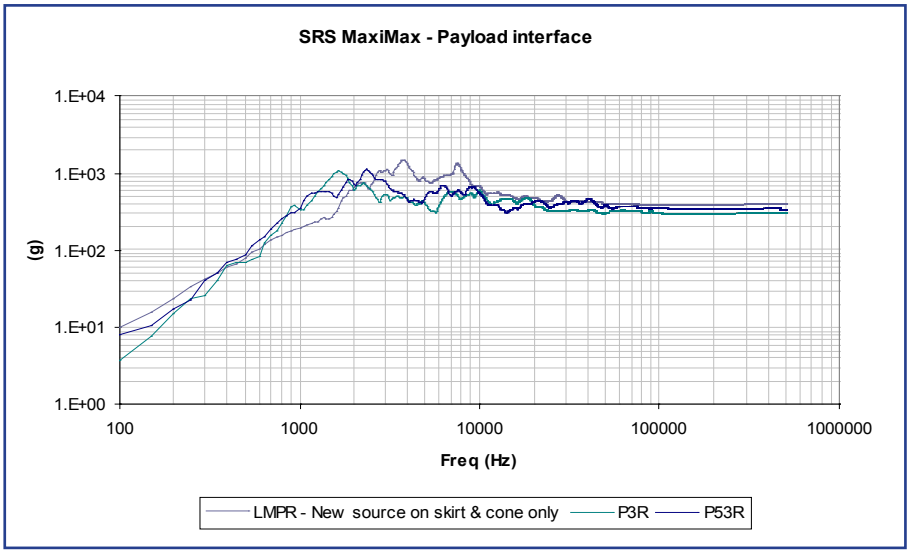
Export Format of time histories and SRS

- TXT
- Universal File Data Set 58
- Export to Excel spreadsheet
- SEA-XP (Experimental SEA software from InterAC)









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