Particle Impact Risk and Vulnerability Assessment Tool PIRAT

The risk for operational satellites of being impacted by small particles is increasing due to the rising amount of space debris in Earth orbits. Even collisions with small particles from sizes of one millimeter upwards can have fatal consequences for satellites, if such particles hit mission-critical equipment placed behind the spacecraft structure.

During the past 17 years, researchers at the Fraunhofer Institute for High-Speed Dynamics, Ernst-Mach-Institut, EMI, in Freiburg have developed the computational methodology and software tool PIRAT Particle Impact Risk and Vulnerability Assessment Tool. PIRAT computes the failure probability from hypervelocity impacts of space debris and micro-meteoroids for each individual spacecraft component.

Spacecraft design engineers use PIRAT to determine the "weak points" in the satellite design with regards to hypervelocity impacts. PIRAT allows to define and to explore protection measures for particularly exposed components easily during early spacecraft design stages. PIRAT quantifies the benefit gained from application of specific protection measures. PIRAT was introduced in 2014 in the European Space Agency's (ESA's) Concurrent Design Facility (CDF) as a tool to support ESA's engineers during Phase 0/A of spacecraft design. The software is available for licensing from EMI.

Workshop content

This workshop provides you with a comprehensive overview of hypervelocity impact effects on spacecraft components and the methods to derive spacecraft equipment survivability numbers based on it. Owing to 25 years of experimental analysis of spacecraft component failures under hypervelocity impacts, Fraunhofer EMI is offering you a unique experience in designing spacecraft systems with high robustness against particle impacts. Each participant at the workshop will receive a trial version of PIRAT and experience hands-on training by the developers of PIRAT.
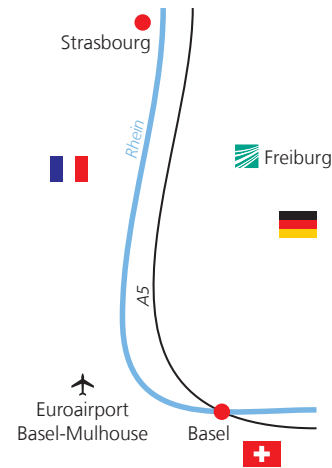
CONTACT

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FRAUNHOFER INSTITUTE FOR HIGH-SPEED DYNAMICS, ERNST-MACH-INSTITUT, EMI

4th PIRAT WORKSHOP & FORUM

NOVEMBER 28–29, 2018

PIRAT-WORKSHOP

FORUM
IMPACT-INDUCED SYSTEM LEVEL EFFECTS
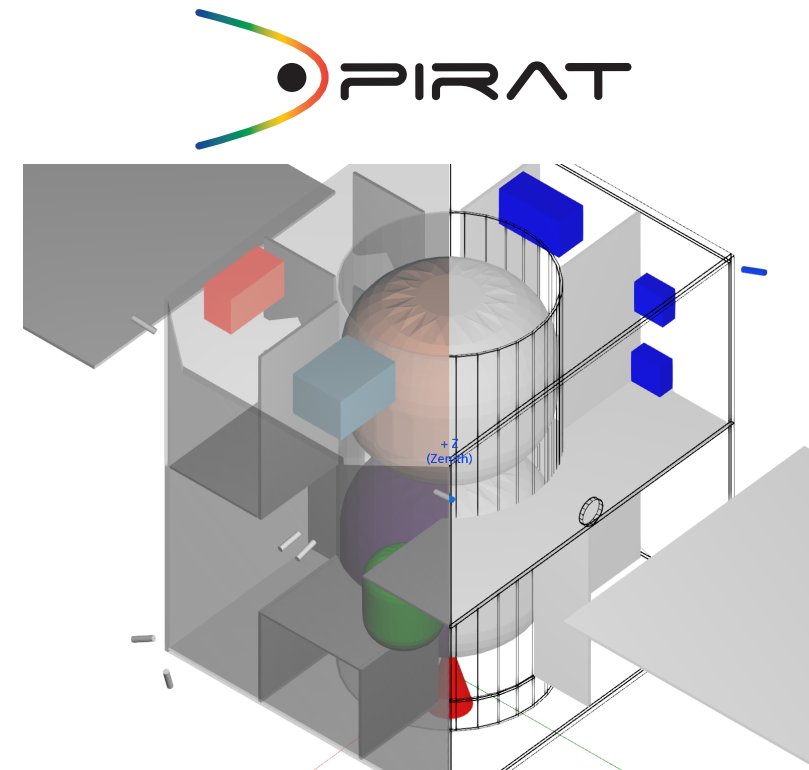
WEDNESDAY, NOVEMBER 28, 2018

12.30 **Arrival**, registration, lunch snack

13.30 **Welcome**, program of the day, participants' expectations
Prof. Frank Schäfer, all

PIRAT quick start
Prof. Frank Schäfer
- Introduction to vulnerability analyses with PIRAT
- PIRAT Tutorial 1

PIRAT fundamentals
Prof. Frank Schäfer and Robin Putzar
a. Flux models, impact effects and failure modes, ballistic limit equations
b. Failure modes and survivability assessment (PIRAT)

- PIRAT Tutorial 2 – Material characteristics tests
- PIRAT Tutorial 3 – Orbital flux tests
- PIRAT Tutorial 4 – IADC test cases

Overview of Fraunhofer EMI
Prof. Frank Schäfer

18.30 **Get-together at Fraunhofer EMI**
Prof. Frank Schäfer

THURSDAY, NOVEMBER 29, 2018

8.30 **PIRAT advanced features**
Prof. Frank Schäfer and Robin Putzar
- Geometric analysis (PIRAT)
- PIRAT Tutorial 5 – Complex geometries, CAD import, analysis settings

Q&A session and conclusion of tutorial

11.00 **End of workshop**

THURSDAY, NOVEMBER 29, 2018

11.15 **Forum "Impact-induced system level effects"**
Prof. Frank Schäfer

The objective of this forum is to discuss the implications of impacts at spacecraft system level. Topics cover the application of impact risk assessment tools for component and mission risk investigation, analysis of component and system reliability with regards to the particulate environment, fault-tree analysis, impact-induced break-up modelling of spacecraft fragmentation, models and methods for structural break-up investigations.

Abstract submission is open now. Please send an abstract of 1/2 page (in English) until the end of September 2018 to frank.schaefer@emi.fraunhofer.de.

15.00 **End of forum**

15.00 – 16.30 **EMI facility tour**

REGISTRATION AND ORGANIZATIONAL NOTES

The workshop language is English.

Registration fee
Registration fee amounts to 120 euros.
Ministries and public authorities are free of charge.

The registration fee includes:

- Participation in workshop and forum
- PIRAT evaluation kit
- Lunch and coffee breaks
- Get-together

Payment
Please pay via bank transfer.
After registration, you will receive an invoice with the bank details.

Off-site participation: Access will be granted through web conference (restricted number of participants).