ACES Student Programming Competition

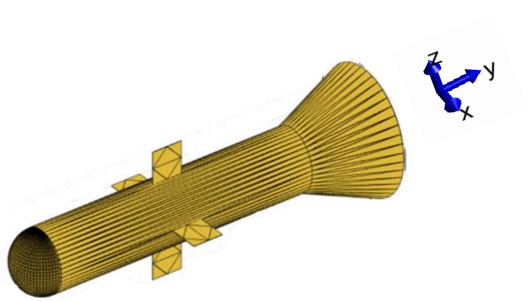
Speed up the electromagnetic analysis of Radar cross-section (RCS)

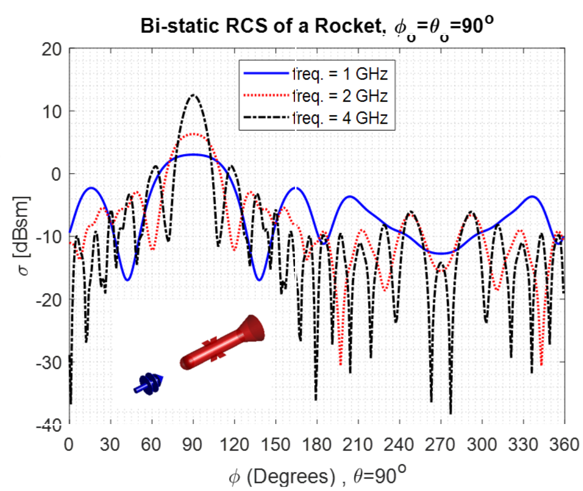
Learn about electromagnetic analysis

Use and compare different electromagnetic analysis techniques to compute the RCS of objects excited with plane waves. In this competition, you will analyze the RCS of a rocket described by means of an STL file defining its geometry.

- Import and visualize the STL file representing the rocket
- Use any of these well-known electromagnetic methods FDTD, MoM, or FMM to compute the rocket RCS at different frequencies and different incident plane wave angles
- Compare results, and identify pros and cons
- Use complimentary MATLAB and Antenna Toolbox to develop, verify, and document your solution.
- Using a PC with a multicore processor and/or GPU and the complimentary MATLAB Parallel Processing Toolboxes to accelerate the RCS analysis without compromising the fidelity of the results.
- Write a technical paper and share it with an international community of experts across academia and industry
- Papers from the top three team winners will be encouraged for submission to ACES Journal for publication.

Rocket configuration and sample results are shown below





Find more information here:

aces-society.org/student-competition

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Goal

Analyze the RCS of a rocket described by means of a STL file (dataset provided). Using MATLAB as a programming platform (R2022b – update 3) you can use different EM solving techniques, such as FDTD, MoM, or FMM, and compare with provided reference results within the given accuracy limits.

The excitation should be a plane wave with these properties:

- Excitation 1. Theta = 90 and phi = 90, E theta = 1, E phi = 0. The wave is pointing towards the positive y-axis.
- Excitation 2. Theta = 0 and phi = 0, E theta = 0, E phi = 1. wave is coming from the bottom and pointing towards positive z.

The goal of the challenge is to speed up the RCS analysis by parallelizing its computation using multi-core and GPU hardware. Every participating team should provide:

- A MATLAB source code to reproduce results with well-documented input and output parameters, which include the arbitrary plane wave incident angles, wave polarization, output RCS plane cut, and frequency. It is possible to use other source codes with your modification, with the proper citation of the original source code.
- A detailed report describing the solution method and its implementation. The report can be in Microsoft Word or pdf format.
- A PowerPoint file with the narration included in every slide. The file should be saved with the pptx extension.

Eligibility

Any team composed of at most one faculty member, at most one graduate student, and up to two (2), undergraduate students is welcome to join this open competition.

Judging Criteria

- Accuracy of the generated RCS patterns (40%),
- The execution time for generating five RCS patterns at five different frequencies (40%),
- The quality of the submitted report and the PowerPoint presentation (20%).

Project files & Support Software

- One MATLAB license for 6 months, including Antenna Toolbox and Parallel Computing Toolbox
- <Rocket STL file>, and an example MATLAB code to read it

Prize

The three teams with the highest performance will be selected as finalists and will be invited to participate in the final competition presentation at ACES 2023. The champion team will receive a grand prize of $300. The first and the second runner-up will receive a prize of $200 and $100, respectively, in addition to complimentary conference registrations to all and expedited paper publication in ACES Journal.

Important Dates

- July 14, 2023 — Competition announcement
- October 4, 2023 — Team registration
- March 4, 2024 — Team's work submission
- April 1st, 2024 — Announcement of the finalists
- May 19-23, 2024 — Team presentation at ACES 2024 Conference

Registration and Submission

Register by email to ***sima_noghanian@ieee.org***

The registration email should include:

- Team name
- Team members and their affiliation
- Team's contact person's email address

Submission instructions will be sent later by email.

Organizers and Sponsors

This competition is organized and sponsored by the Applied Computational Electromagnetic Society (ACES) and MathWorks.

References

- "Radar Signal Analysis", Bassem Mahafza, Scott Winton, and Atef Elsherbeni, Handbook of Radar Signal Analysis, CRC Press, 2021 – Pages 488 to 490
- "Antenna and EM Modeling with MATLAB Antenna Toolbox", 2nd edition, Sergey N. Makarov, Vishwanath Iyer, Shashank Kulkarni, Steven R. Best
- *https://www.mathworks.com/help/antenna/ug/radar-cross-section-benchmarking.html*
- Parallel Computing Fundamentals *https://www.mathworks.com/help/parallel-computing/parallel-computing-fundamentals.html*
- "MATLAB®: A Language for Parallel Computing", International Journal of Parallel Programming, Springer 2009, G. Sharma, J. Martin