

ACES Student Programming Competition

Microstrip Antenna Miniaturization using Pixelization

Participate in the Applied Computation Electromagnetics Society (ACES) student competition and win the opportunity to publish your paper in ACES Journal.

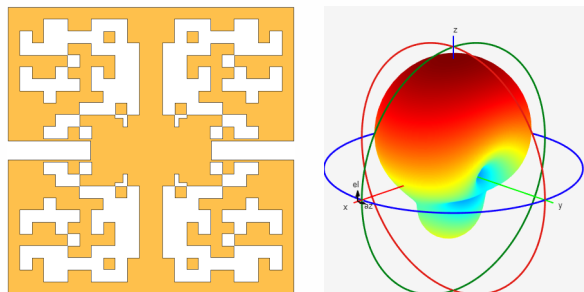
Goal

The goal of this competition is to miniaturize a microstrip patch antenna on an air substrate and backed by a PEC ground plane using MATLAB as a programming platform.

You can use any of the MATLAB toolboxes and functions to:

- Minimize the resonance frequency, while keeping the maximum area of the radiating patch constant, as given below
- Maximize the input impedance bandwidth, and
- Maximize the realized gain at the resonance frequency.

The substrate material, maximum available size, and thickness are fixed as listed in the table below. You are only allowed to change the patch shape and size within the allowed maximum area in a pixelized form and the feeding point position. The polarization and main beam direction of the designed antenna should remain the same as those of a solid patch antenna occupying the maximum patch size allowed. The antenna design parameters are summarized in the following table.

Original Antenna Design Parameters		
Maximum area for the radiating patch	53 mm × 53 mm	Sample of Pixelized Patch and Radiation Pattern 
Maximum Ground Plane and Substrate Size	100 mm × 100 mm	
Substrate Material	Air	
Substrate Thickness	4.3 mm	
Initial Resonance Frequency	2.6 GHz	
Initial Impedance Bandwidth	80 MHz	

Eligibility

Any team composed of a maximum of 2 students and one faculty advisor is welcome to join this open competition. Multiple teams from the same institution are allowed.

Support Software

Upon request, MathWorks can provide complimentary MATLAB software licenses and self-paced online training for this competition. Participating teams who need software or access to online training resources can contact sima_noghanian@ieee.org.

Deliverable

Every participating team should provide:

- A well-documented MATLAB source code to reproduce results with input and output parameters, which include antenna structure, reflection coefficient versus frequency (frequency axis should be centered at the resonant frequency and extended on both sides by 1 GHz), 2D (x-y, x-z, and y-z planes) and 3D far-field realized gain patterns in dB scale, and radiation efficiency.
- A detailed report describing the solution method and its implementation. The report can be in Microsoft Word or PDF format, following ACES Journal template, which is available [here](#).
- A PowerPoint file with the narration included in every slide and saved with the .pptx extension. This file should be suitable for detailing the project objectives, design details, results, and conclusions.

Judging Criteria

The following parameters constitute the judging.:

- Reduction of resonance frequency compared to 2.6 GHz (25%)
- input impedance bandwidth of at least 20 MHz (25%),
- maximum realized gain (25%)
- Quality of the submitted report and the PowerPoint presentation files (25%).

Prize

The three teams with the highest performance will be selected as finalists and will be invited to submit a journal paper (with waived publication charges) to ACES journal for possible publication after conducting the review process. They will also receive certificates from ACES and MathWorks for their participation in the competition. ACES Society will present the champion team with a grand prize of \$300. The second and the second runner-up will receive prizes of \$200 and \$100, respectively. The champion team members will receive a complimentary conference registration for attending ACES 2027 Conference.

Important Dates

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|--------------------|---------------------------------|
| • October 31, 2025 | Competition announcement |
| • Nov 30, 2025 | Team registration closes |
| • May 31, 2026 | Team's work submission deadline |
| • July 31, 2026 | Announcement of the top 3 teams |

Registration and Submission

Teams should register by sending the following information to sima_noghanian@ieee.org:

- Team's name
- Team members' names and educational status (undergraduate, graduate)
- The faculty advisor's name and affiliation
- Team's contact person's email address

Organizers and Sponsors

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

References

- J. M. Johnson and Y. Rahmat-Samii, "Genetic Algorithm and Method of Moments (GA/MOM) for the Design of Integrated Antennas," IEEE Transactions on Antennas and Propagation, vol. 47, no. 10, pp.1606-1614, Oct. 1999.
- J. M. Johnson and Y. Rahmat-Samii; "Genetic Algorithms in Engineering Electromagnetics," IEEE Magaz. Antennas Propag., vol. 39, pp. 7–40, August 1997.
- Y. Rahmat-Samii and E. Michielssen, Eds., Electromagnetic Optimization by Genetic Algorithms, John Wiley & Sons, 1999.
- S. Noghanian, R. Fazel-Rezai, H.T. Nguyen, A. Sabouni, and L. Shafai, "Microstrip Antenna Miniturization using Slot-Loading," IEEE International Symposium on Antennas and Propagation, Ottawa, Canada, 2025.
- "Antenna and EM Modeling with MATLAB Antenna Toolbox", 2nd edition, Sergey N. Makarov, Vishwanath Iyer, Shashank Kulkarni, Steven R. Best, April 2021, DOI:10.1002/9781119693710.