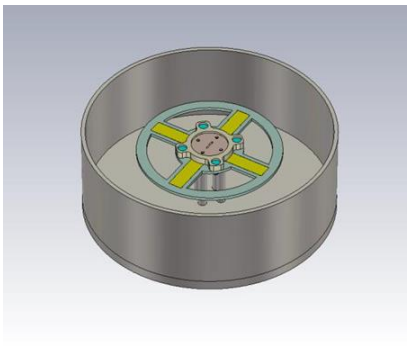
Test case 7: Antenna on UAV

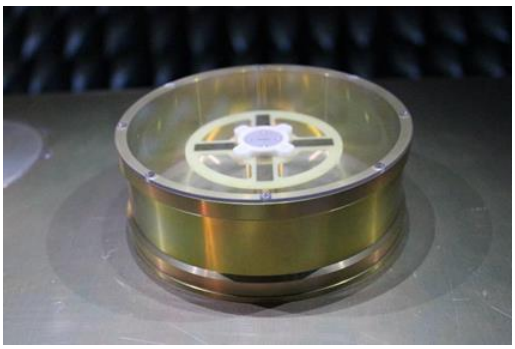
Quentin.Carayol@dassault-aviation.com and lucia.scialacqua@mvg-world.com

The goal of this test case is to simulate an antenna installed on a large structure. The simulation can be done either by using the detailed definition of the antenna, or by using Electric and Magnetic fields on a Huygens surface surrounding the antenna.

Antenna Description

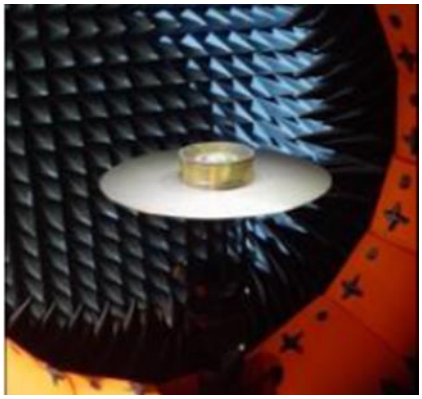
The antenna is an L-band cavity backed crossed dipoles antenna, with an external diameter of 124mm and a height of 47mm. The proposed frequency of simulation is 1940MHz.

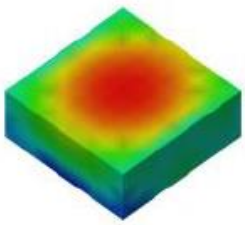




The detailed geometry and materials can be provided on demand by MVG (lucia.scialacqua@mvg-world.com) under NDA conditions.

However, instead of simulating the detailed antenna, participants can choose to use the equivalent Electric and Magnetic fields on a parallelepipedic Huygens surface, generated by MVG from measurement data [1-3]. These fields are available online in the file "modelVertexFields_1940000KHz_Gain.txt", which contains all the vertices coordinates of the Huygens box and the corresponding values of Electric and Magnetic field components (real and imaginary parts). It shoud be noticed that these equivalent fields correspond to a null internal field inside the Huygens box, and that calculation of radiated field is valid only toward outside the source.



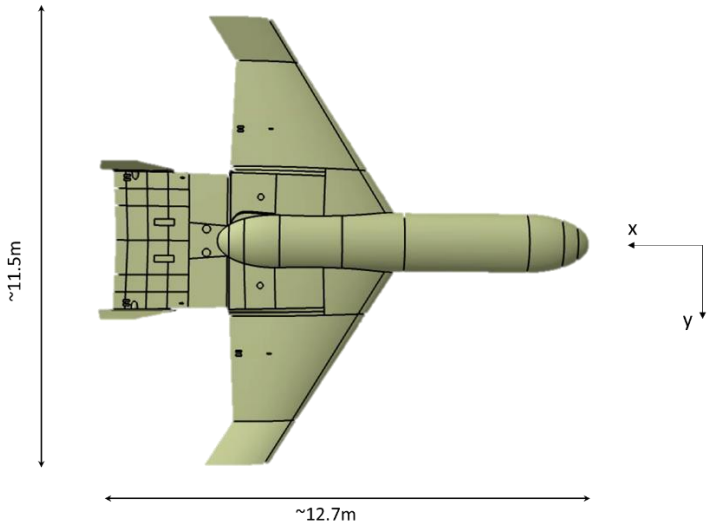


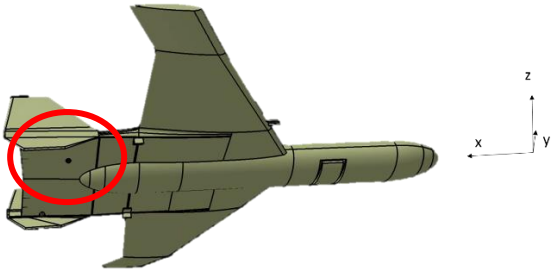
Antenna measurement on ground plane => *Huygens box*

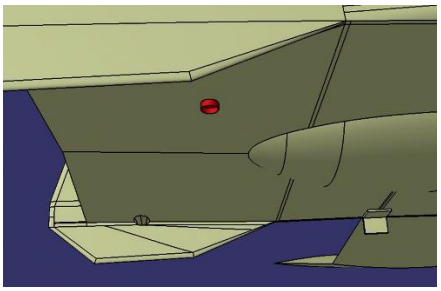
UAV Description

The geometrical files of the UAV are available.

Views of the UAV are presented below:





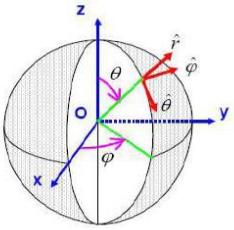


Antenna location on the lower surface of the air vehicle

The given antenna geometry has to be translated along vector **v=(11147.1, 850.3, -145.7)**, and then rotated around its local y axis, with an angle **α=176.838°**, in order to be located correctly on the aircraft.

For the Huygens box, the same operations must be done, except that the translation vector is **v'=(11147.1, 850.3, -140.7)**, due to a shift of 5mm in the local origins.

Expected results



It is requested to compute the far field radiation pattern with the following conditions :

- The time dependency is assumed to be $exp(jwt)$

- Radiation pattern at 1940MHz

- Theta scanning -180° to 180°, step 0.5°

- Phi cut 0°, 45°, 90°

- Both components E_φ and E_θ should be computed

- A normalization factor should be applied to the radiated field :

for example $\max_{\theta\epsilon[-180,180],\varphi\epsilon\{0,45,90\}}(|E|)$

The pattern will be stored in columns in an array with the following form :

[Theta] , [Phi] , [20log(|Eθ|)] , [arg(|Eθ|)] , [20log(|Eφ|)] , [arg(|Eφ|)]

Moreover, participants must provide an additional file containing at least :

- The method used (with relevant parameters)

- Number of degrees of freedom

- Total computation time

- Number and nature of processors

References

[1] J. Araque and G. Vecchi, “Improved-accuracy source reconstruction on arbitrary 3-D surfaces,” IEEE Antennas Wireless Propag. Lett., vol. 8, pp. 1046–1049, 2009

[2] L. J. Foged, L. Scialacqua, F. Saccardi, F. Mioc, D. Tallini, E. Leroux, U. Becker, J. L. Araque Quijano, G. Vecchi, “Bringing Numerical Simulation and Antenna Measurements Together”, IEEE Antennas and Propagation Society International Symposium, July 2014.

[3] M.A.Saporetti, L. Scialacqua, F. Saccardi, L.J. Foged J. Zackrisson, D. Trenta, L. Salghetti Drioli, “Improved Measured Source Antenna Representation in Satellite Antenna Placement Analysis with Numerical Simulation”, IEEE Antennas and Propagation Society International Symposium, July 8-13, 2018, Boston, Massachussets, USA