CZECH TECHNICAL UNIVERSITY IN PRAGUE
DEPARTMENT OF ELECTROMAGNETIC FIELD
TECHNICKÁ 2, 166 27 PRAHA 6, CZECH REPUBLIC
INFO@ANTENNATOOLBOX.COM, +420 224 352 280
WWW.ANTENNATOOLBOX.COM

SIMULATION OF A 4-ARM FOLDED HELIX ANTENNA

SHORT TECHNICAL PAPER

INTRODUCTION

In this short technical paper, a simulation of a electrically small helix antenna with the AToM [1] package is presented. The structure is a four-arm folded helix antenna based on [2-4] and fed by four in-phase voltage gaps. This antenna basically resembles a twisted folded dipole. Multiple arms serve to increase its radiation resistance.

SIMULATION SETUP

The simulation setup is fully script-oriented and just a few MATLAB [5] lines is required to perform the analysis. A section of start up-sequence is shown in Fig. 1. It is readily seen how the four voltage gaps are set up at pairs of particular triangles. A given mesh from FEKO [6] is loaded (see Fig. 2.) and order of numerical quadrature for MoM interaction integrals is in this case just only one (which is enough as we will see later).

```
%% Simulation setup
% excitation (struct 1x1)
Simulation.Excitation = struct(...
   'type', 'deltaGap', ...
   'voltage', [1; 1; 1; 1], ...
   'triangles', [1216 1167; 849 655; 104 1580; 909 637]);

% mesh (nodes Mx3, triangles Nx3)
Simulation.Mesh = load('mesh.mat', 'nodes', 'triangles');

% numerical quadrature (sequentially increasing integers 1xN)
Simulation.quadOrderList = 1;
```

Fig. 1. Section of setup script for simulation

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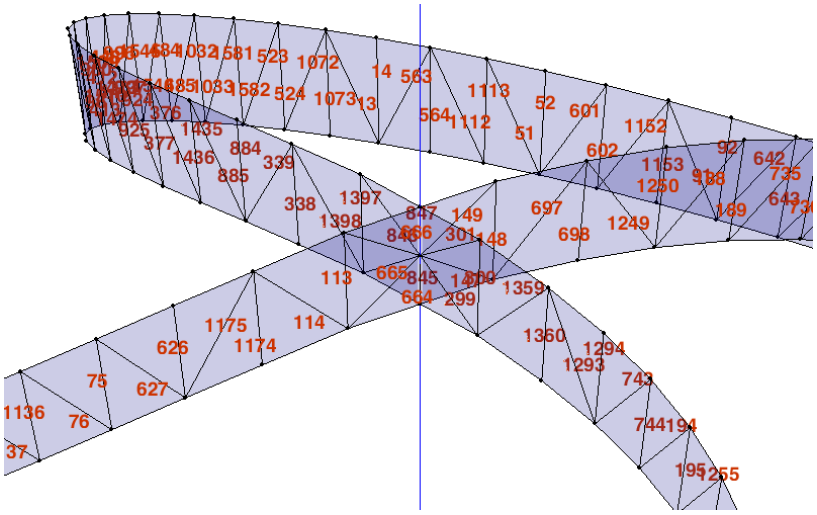

Fig. 2. Part of the mesh as shown by AToM mesh viewer. Triangle numbering is on.

RESULTS

The input impedance is compared with commercial solvers FEKO and CEM One [7]. Despite the basic quadrature settings, results are excellent as illustrated in Fig. 3

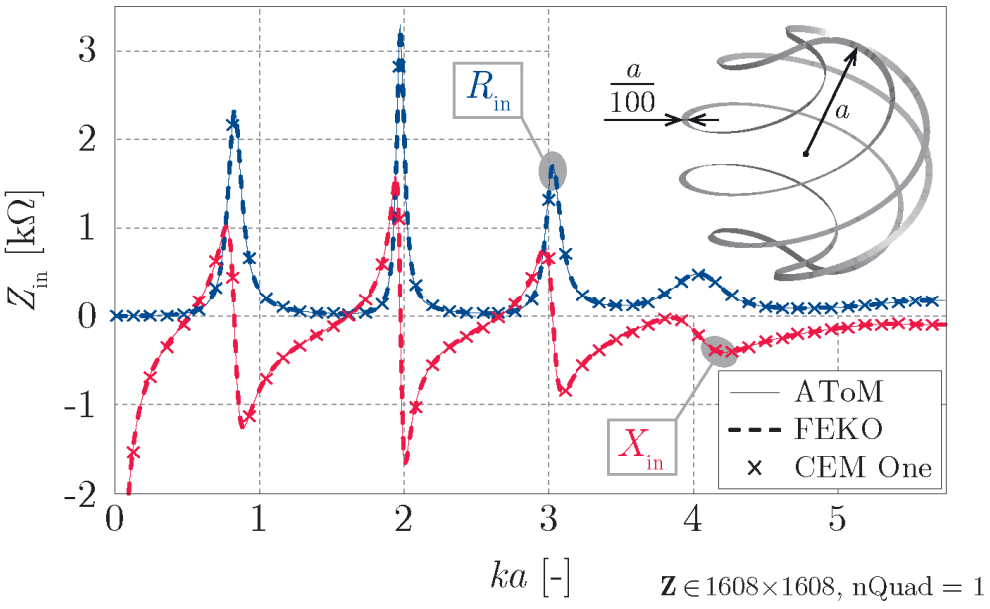

Fig. 3. Input impedance at one of the four ports from AToM, FEKO and CEM One.

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The antenna is self-resonant at $ka = 0.5$ with the real part of driving resistance close to 50Ω. The surface currents for this resonance are shown in Fig. 4 where it is seen that basically there are four twisted dipoles with half-wavelength distribution.

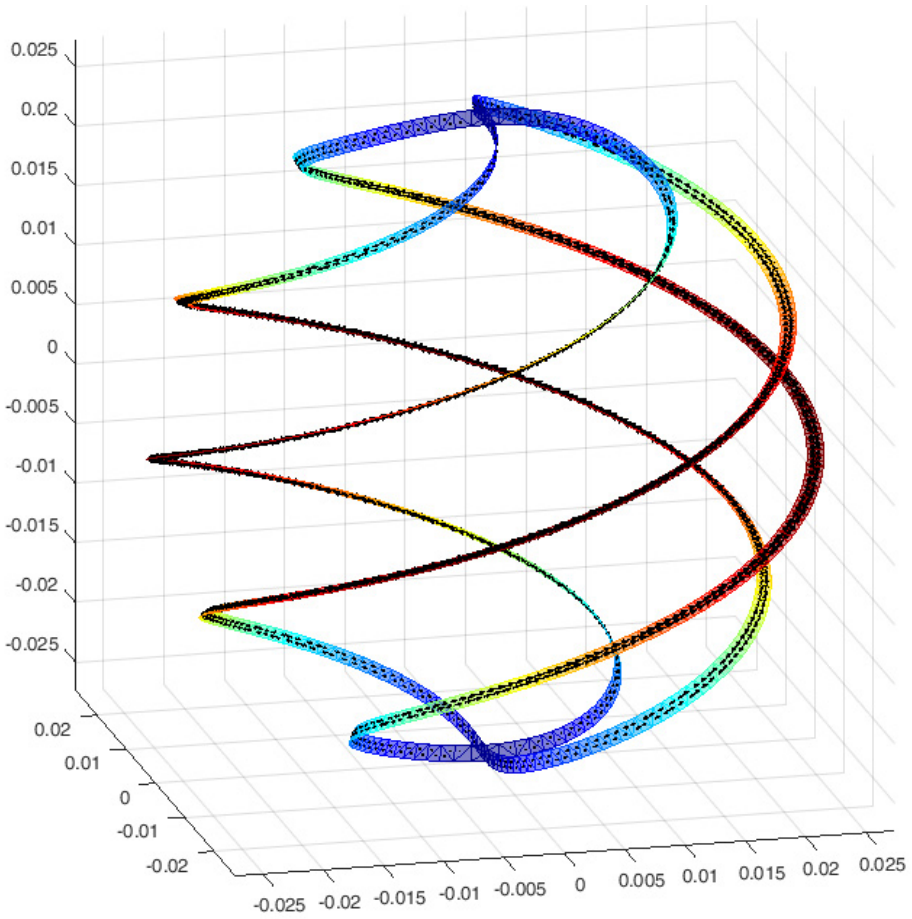

Fig. 4. Surface current distribution calculated by AToM at fundamental resonance.

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[2] Best, S. R., The Radiation Properties of Electrically Small Folded Spherical Helix Antennas, *IEEE Transactions on Antennas and Propagation*, vol. 52 no. 4, April 2004

[3] Best, S. R., The Quality Factor of the Folded Cylindrical Helix, *Radioengineering*, vol. 18, no. 4, December 2009

[4] Best, S. R., Low Q Electrically Small Linear and Elliptical Polarized Spherical Dipole Antennas, *IEEE Transactions on Antennas and Propagation*, vol. 53 no.3, March 2005

[5] MATLAB, online: www.mathworks.com

[6] FEKO, online: www.feko.info

[7] CEM One, online:

https://www.esi-group.com/software-solutions/virtual-environment/electromagnetics/cem-one