

Raytracing in Python Utilizing the PHaRLAP Engine

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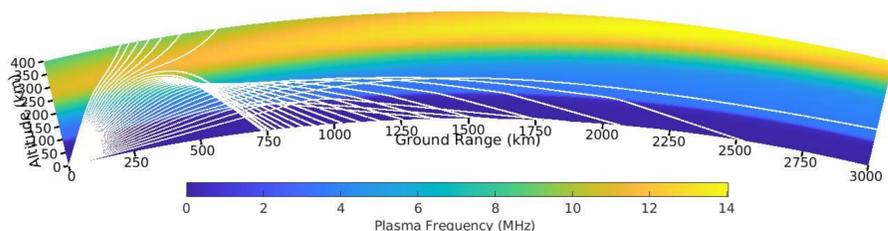
Abstract

Provision of High-Frequency Raytracing Laboratory for Propagation (PHaRLAP) is an ionospheric ray tracing library developed by the Australian Department of Defence (DOD). PHaRLAP is freely available as a MATLAB toolbox downloadable from an Australian DOD website. PHaRLAP is capable of numerically ray tracing radio propagation paths using 2D and 3D algorithms through model ionospheres, most typically the International Reference Ionosphere (IRI). To make PHaRLAP available to a wider user community we are porting the PHaRLAP MATLAB toolbox to the open-source Python 3 language while retaining the original core PHaRLAP computational engine. In this presentation, we describe the architecture of the new Python 3 PHaRLAP interface and demonstrate examples of 2D ray traces using the new interface.

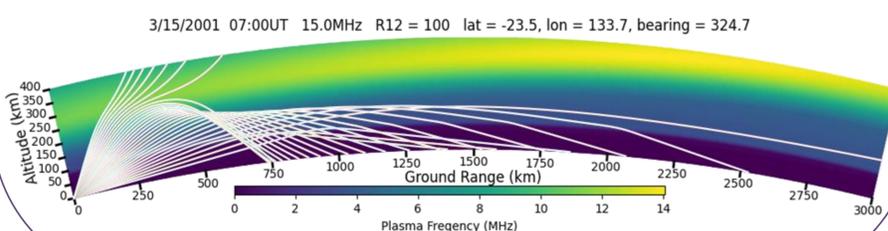
Introduction

- In order to bring PHaRLAP to a wider audience of both researchers and hobbyist, we are developing a Python implementation that will utilize the PHaRLAP engine to raytrace.
- The main issue in developing a new implementation is ensuring that the data values present in the arrays are within a margin of acceptable error. This becomes difficult due to the differences in programming language floating point representation.

Original PHaRLAP (MATLAB)

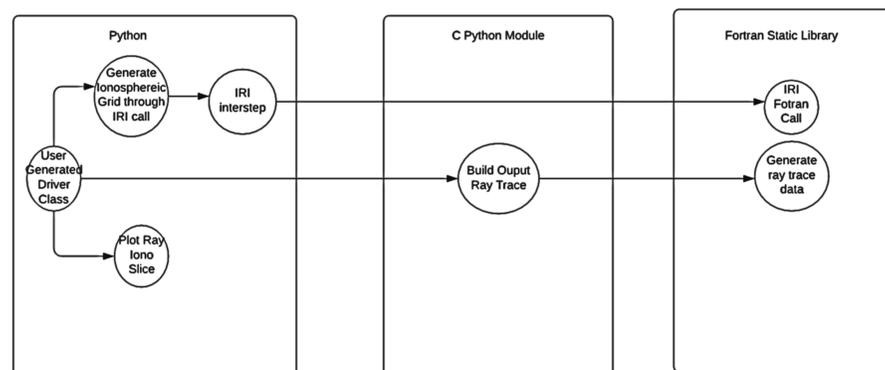


Python Implementation



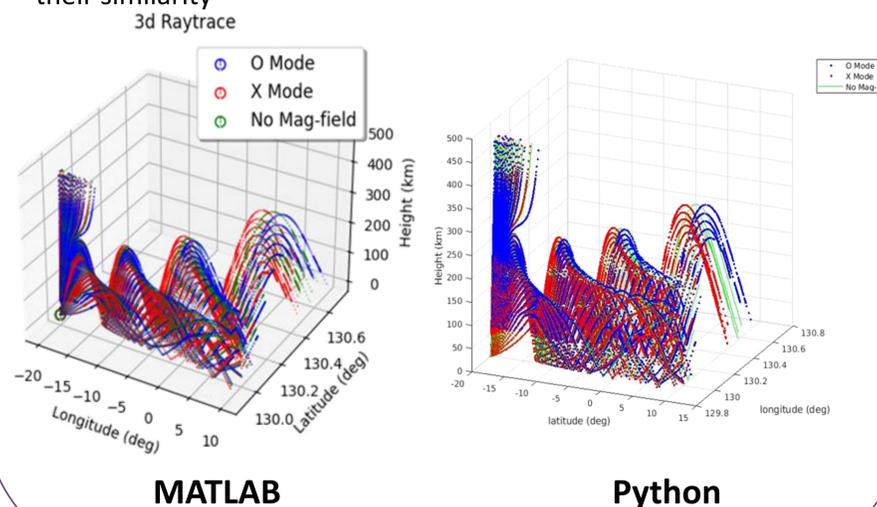
Methodology

- How does PHaRLAP interact with the project
 - PHaRLAP Engine made up of blackboxed Fortran static library objects (.so files)
 - .so files contain the differential equation math needed to generate the raytraces
 - .so file function calls are made in the C-Python modules after data validation
- Project Structure
 - User viewable Python code
 - C Source file Python Modules
 - Fortran .so files



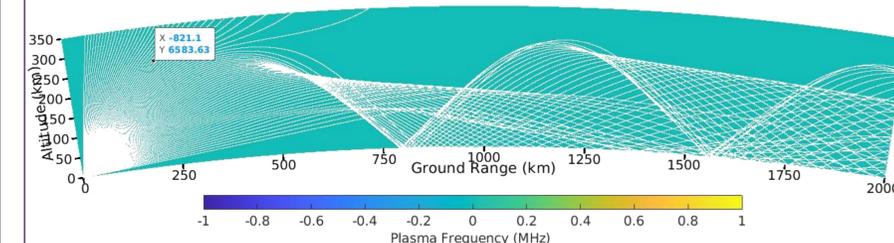
3D Raytracing

Below are side by side raytrace examples from the MATLAB implementation and the python implementation to demonstrate their similarity

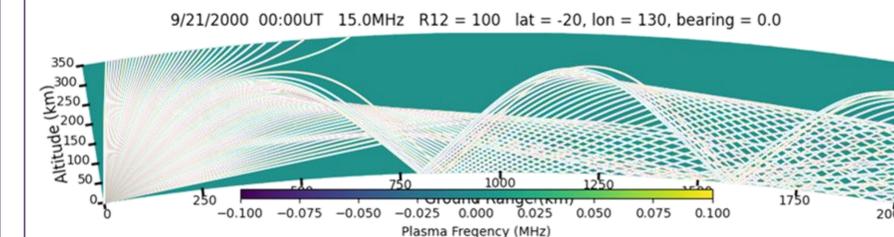


2D Raytracing

Original PHaRLAP (MATLAB)



Python Implementation



Summary

- Both 2D and 3D functionality for the Python implementation are within an acceptable range of error
- The Python implementation was developed with the Matlab implementation in mind, thanks to this, the Python implementation functions almost exactly like the Matlab implementation in terms of method calls. This was done in an effort to make the transition to the Python implementation much easier.
- Future progress on the Python implementation involves continuing data validation, code refactoring, and finally implementation.

Acknowledgments

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