The The LTool Package

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LTool is JPL's new mission analysis tool with specialization in libration orbits. It is used by the Genesis Mission for its prelaunch mission design as well as in current post-launch operations. It is also being used by the Terrestrial Planet Mission to study formation flight both in halo orbits and in SIRTF-like heliocentric orbits. It can also be used to design conventional conic-based interplanetary missions. LTool is not a program, but what is known as a Problem Solving Environment which has a Command Line User Interface (CLUI), Graphical User Interface (GUI), and 3D visualization capabilities all integrated into a common software environment. Matlab, Mathematica, and JPL's Quick are other examples of Problem Solving Environments. The user can use LTool interactively, or run LTool in batch mode for larger and longer computations. Various modules enable the users to compute conic orbits, halo orbits, invariant manifolds associated to halo orbits. Using a user-programmable differential corrector (multiple shooting) the various trajectory segments may be "glued together" to produce an end-to-end trajectory. Some of the novel features of LTool are:

- Ability to produce end-to-end trajectories, starting from first guess solutions to fully integrated trajectories with JPL ephemeris models. LTool tracks coordinates and units.
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- Trajectories are handled as abstract continuous functions of time. A function algebra permits users to manipulate trajectory functions algebraically.

In addtion to trajectory design, LTool also provides coverage analysis using a technique called multi-resolution visual calculus. Currently, low thrust trajectory integration module is being added.

The LTool environment is created using the object oriented Python CLUI, with Qt GUI, and OpenGL graphics. The integrated environment is called PyShell. Fortran, C, and C++ modules are pulled into the PyShell environment using UDL (Unified Description Language), a tool developed by the LTool Team. Currently LTool runs under LINUX, but within the year, a Windows version is expected.

This modular architecture allows the users to program at a high level, using a high-level language (Python), while providing speed and flexibility with the Fortran, C, and C++ modules. The various LTool modules provide a high level astrodynamic "programming language". This approach greatly increases the user's ability to prototype and to solve problems interactively.