



System-of-Systems Technology-Portfolio-Analysis Tool

Advanced Technology Life-cycle Analysis System (ATLAS) is a system-of-systems technology-portfolio-analysis software tool. ATLAS affords capabilities to (1) compare estimates of the mass and cost of an engineering system based on competing technological concepts; (2) estimate life-cycle costs of an outer-space-exploration architecture for a specified technology portfolio; (3) collect data on state-of-the-art and forecasted technology performance, and on operations and programs; and (4) calculate an index of the relative programmatic value of a technology portfolio. ATLAS facilitates analysis by providing a library of analytical spreadsheet models for a variety of systems. A single analyst can assemble a representation of a system of systems from the models and build a technology portfolio. Each system model estimates mass, and life-cycle costs are estimated by a common set of cost models.

Other components of ATLAS include graphical-user-interface (GUI) software, algorithms for calculating the aforementioned index, a technology database, a report generator, and a form generator for creating the GUI for the system models. At the time of this reporting, ATLAS is a prototype, embodied in Microsoft Excel and several thousand lines of Visual Basic for Applications that run on both Windows and Macintosh computers.

This program was written by Daniel O'Neil of Marshall Space Flight Center, John Mankins of NASA Headquarters, and Harvey Feingold and Wayne Johnson of Science Applications International Corp. For further information, contact Sammy Nabors, MSFC Commercialization Assistance Lead, at sammy.a.nabors@nasa.gov. Refer to MFS-32291-1

VESGEN Software for Mapping and Quantification of Vascular Regulators

VESSEL GENeration (VESGEN) Analysis is an automated software that maps and quantifies effects of vascular regulators on vascular morphology by

analyzing important vessel parameters. Quantification parameters include vessel diameter, length, branch points, density, and fractal dimension. For vascular trees, measurements are reported as dependent functions of vessel branching generation.

VESGEN maps and quantifies vascular morphological events according to fractal-based vascular branching generation. It also relies on careful imaging of branching and networked vascular form. It was developed as a plug-in for ImageJ (National Institutes of Health, USA). VESGEN uses image-processing concepts of 8-neighbor pixel connectivity, skeleton, and distance map to analyze 2D, black-and-white (binary) images of vascular trees, networks, and tree-network composites. VESGEN maps typically 5 to 12 (or more) generations of vascular branching, starting from a single parent vessel. These generations are tracked and measured for critical vascular parameters that include vessel diameter, length, density and number, and tortuosity per branching generation. The effects of vascular therapeutics and regulators on vascular morphology and branching tested in human clinical or laboratory animal experimental studies are quantified by comparing vascular parameters with control groups.

VESGEN provides a user interface to both guide and allow control over the users' vascular analysis process. An option is provided to select a morphological tissue type of vascular trees, network or tree-network composites, which determines the general collections of algorithms, intermediate images, and output images and measurements that will be produced.

VESGEN was used to map and quantify progression of human diabetic retinopathy (DR), a vascular disease that is the major cause of blindness in working-aged adults. VESGEN maps and quantifies site-specific characteristics such as vessel diameter, number, and length based on bifurcated generational branching within retinal arterial and venous trees. To analyze ophthalmic clinical images of the human retina as a new VESGEN modification, VESGEN was modified to detect and analyze the first branching generation (parent) vessel when that vessel originates at a region of interest (ROI) located within the image

(not just at the edge of an image, as for previous VESGEN studies). Other applications include remodeling coronary vessels, tumor vessels, rodent retinal experiments, gastrointestinal inflammation, and cytokine or drug regulation in *in vivo* models.

VESGEN also can be used for the mapping and quantification of remodeling of plant leaf venation patterns in response to plant growth, genetic engineering, and other growth perturbants. Providing VESGEN as a plug-in also makes it easily distributable, able to be run on many computer platforms, and readily utilized by other researchers.

This work was done by Patricia A. Parsons-Wingenter, Mary B. Vickerman, and Patricia A. Keith of Glenn Research Center. Further information is contained in a TSP (see page 1).

Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Innovative Partnerships Office, Attn: Steven Fedor, Mail Stop 4-8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-18722-1/3-1/4-1.

Constructing a Database From Multiple 2D Images for Camera Pose Estimation and Robot Localization

The LMDB (Landmark Database) Builder software identifies persistent image features ("landmarks") in a scene viewed multiple times and precisely estimates the landmarks' 3D world positions. The software receives as input multiple 2D images of approximately the same scene, along with an initial guess of the camera poses for each image, and a table of features matched pair-wise in each frame. LMDB Builder aggregates landmarks across an arbitrarily large collection of frames with matched features. Range data from stereo vision processing can also be passed to improve the initial guess of the 3D point estimates. The LMDB Builder aggregates feature lists across all frames, manages the process to promote selected features to landmarks, and iteratively calculates the 3D landmark positions using the current camera pose estimations (via an optical ray projection method), and then improves the camera pose estimates