University of Central Florida
3280 Progress Drive, Orlando, FL 32826
407-882-1300 / www.ist.ucf.edu

ZCAP Research and Development

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ZCAP is a suite of software tools developed to address terrain database interoperability. It provides capabilities for terrain and culture correlation testing, terrain and image registration, database analysis and terrain database visualization

ZCAP 4.1 TOOLS

SPATIAL CORRELATION TESTS:

Terrain Correlation Test

Computes statistics on elevation differences at locations chosen from a uniform random distribution – conducts statistical hypothesis test of terrain correlation based upon the "accuracy proportion" (*i.e.* # of elevation differences below threshold elevation difference/total # of elevation differences (critical value)).

Capabilities: Computes mean, median, variance, standard deviation, amount of skew, kurtosis, magnitude of the maximum elevation difference, and critical value statistics based upon the elevation differences.

Intended Use: Automated statistical analysis of terrain elevation errors and assessment of interoperability in an exercise.

Culture Correlation Test

Computes statistics on culture feature classification differences between a reference or "baseline" terrain database and a subject terrain database at stratified random locations on culture features of user-defined classes from the "baseline" terrain database – conducts statistical hypothesis test of culture feature classification correlation based upon the kappa statistic (i.e., p_o - p_e/1 - p_e , where p_o is the overall proportion of agreement and p_e is the adjustment due to chance expected agreement)

Capabilities: Computes a contingency table of culture feature classification/misclassification proportions and the kappa statistic (based upon that contingency table).

Intended Use: Automated statistical analysis of culture feature classification errors and assessment of interoperability in an exercise.

Line-Of-Sight (LOS) Correlation Test

Computes statistics on LOS differences between culture features (including terrain) in a reference or "baseline" terrain database and a subject terrain database at stratified random locations on culture features of user-defined classes from the "baseline" terrain database. The LOS is measured along vectors with length equal to the "separation distance" and at random directions, the starting point of which are the stratified random locations. The separation distance is the distance between random pairs of points over the baseline database that yields a probability of LOS of 50% (which gives the LOS test its maximum sensitivity to culture miscorrelation) – conducts statistical hypothesis test of LOS correlation based upon the kappa statistic.

Capabilities: Computes a contingency table of Boolean LOS (true/false values) proportions and a contingency table of intervening features causing miscorrelation of LOS and the kappa statistics based upon these contingency tables. The kappa statistics are used to perform a hypothesis testing procedure in the same way as for the Culture Correlation Test.

Intended Use: Automated statistical analysis of LOS errors and assessment of interoperability in an exercise.

OTHER TESTS:

Shift Detection Test
Detects horizontal shifts in terrain surfaces.

Capabilities: Utilizes a Sequential Similarity Detection Algorithm (SSDA) to perform a normalized cross-correlation between two uniform gridded samples of two terrain surfaces.

Intended Use: Detection of shifts in a terrain skin due to inaccurate coordinate transformations (including improper datum shifts).

VISUALIZATION TOOLS:

Contour Visualization
Contour generation and visualization of 3D polygonal terrain surfaces (including hypsometric color maps) – allows comparison of contours between two terrain databases.

Feature Overlay Visualizer
Overlays 2D or 3D culture features from two terrain databases – allows visual comparison of culture feature discrepancies.

LOS Visualization
Displays a LOS map ("fan plot") for a terrain database from a user-defined eye-point and LOS angle – can overlay LOS maps from two terrain databases.

"Side-by-Side Stealth"
Side-by-side 3D perspective visualization of two terrain databases in which the viewpoint is registered in the two rendered scenes – allows the user to manipulate the lighting model, view frustum and viewpoint (including movement of the viewpoint).

UTILITIES:

Sample Point Generator
Generates random geodetic or UTM coordinates for sampling elevation values from terrain databases – can also generate uniform (gridded) geodetic or UTM coordinates (when desired).

Interpolation Tool
Interpolates on two dimensional gridded data using cubic splines – for example, to allow elevation sampling on a (smooth) terrain surface – can be used to develop "adaptive" sampling schemes based upon the variance of a given terrain attribute (such as elevation) over sub-regions.

Triangulation Tool
Constructs a triangulated surface from regular or irregular points in space – constructs Triangulated Irregular Networks (TINs) via the Delaunay triangulation algorithm or a radial sweep algorithm – can also triangulate regular gridded points using right, left, or mixed isosceles triangulation.

Coordinate Conversion Tool
Converts coordinates between different coordinate systems (performing a horizontal datum shift when necessary) – can convert (bidirectionally) between geocentric and geodetic, geodetic and UTM, and geocentric and UTM.

OTHER TOOLS:

Terrain Remediation Tool
Adjusts terrain skin elevations for the purpose of minimizing correlation errors between terrain skins with different resolutions and different polygonizations – only adjusts terrain polygon vertices; maintains polygonization method and polygon counts – Utilizes a constrained least-squares surface adjustment algorithm to fit a given polygonized surface to a reference surface.

INPUT COMPATIBILITY:

ZCAP is input compatible with: MultiGen® OpenFlight™, S1000, SIF, CCTT MRTDB*, & E&S GDF**

* Only gridded terrain, linears, surface linears, "cut and fill" linears, and micro-terrain

** Requires proprietary E&S "DET" API.

Contact:
Art Cortes
Project Manager
407-882-1337 cortes@ist.ucf.edu