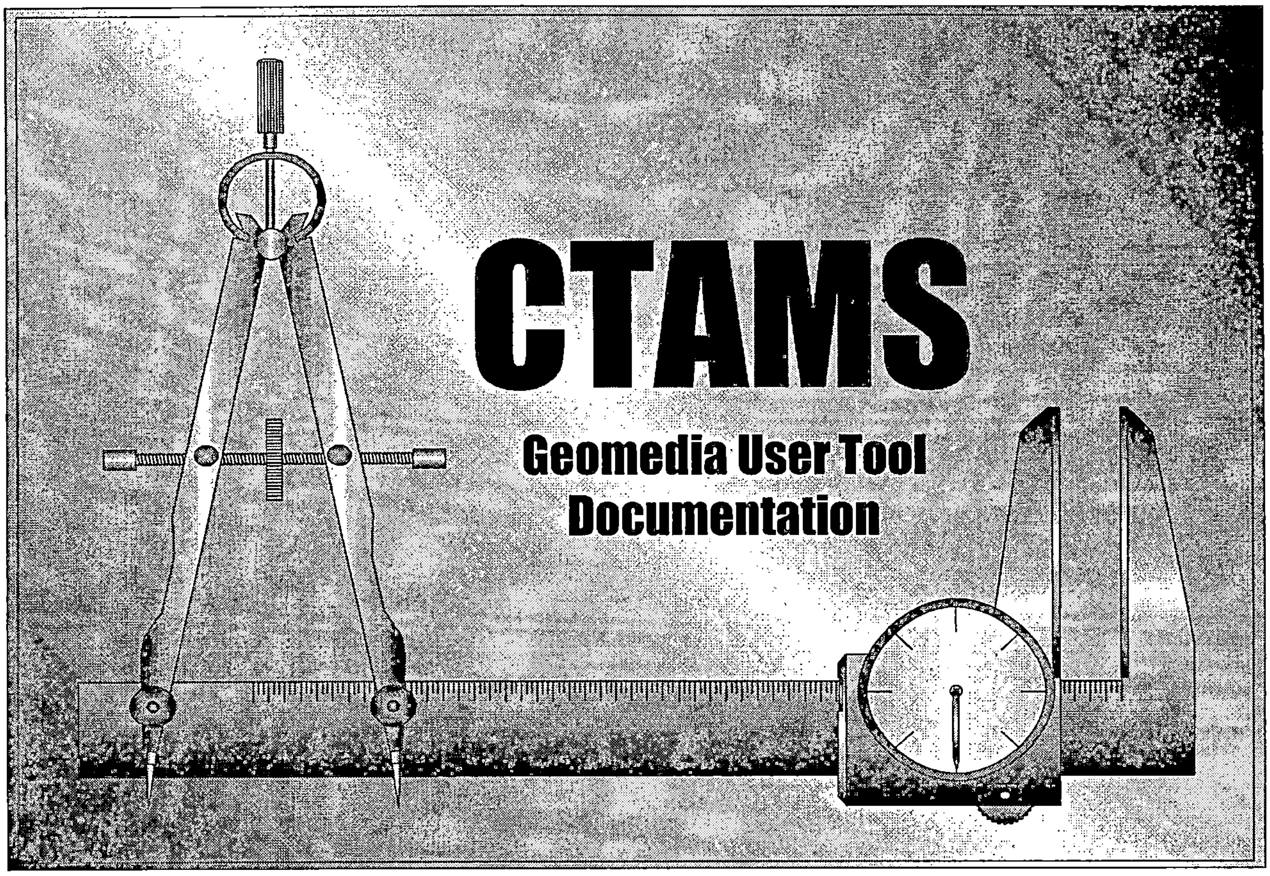

Iowa Department of Transportation
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800 Lincoln Way
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Prepared for:
The Iowa Department of Transportation

Prepared by:
The Center for Transportation Research and Education

Iowa DOT GIS CTAMS
Coordinated Transportation Analysis and Management System

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CTAMS
GeoMedia User Tool Documentation and Technical GIS Concepts

July 1998

Prepared for:
The Iowa Department of Transportation

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Introduction to Windows Terminology

Many of the user instructions contained in this documentation refer to the user interface forms and dialog boxes, which send and receive information between the program and the user. Figure 1 illustrates the different Windows components (called controls) referred to in this documentation. Disabled controls appear "dimmed" to the user. When controls of these types are referred to in this document, they will appear in **bold** type. For example: "The user should click the **Connect Button** to connect to the warehouse".

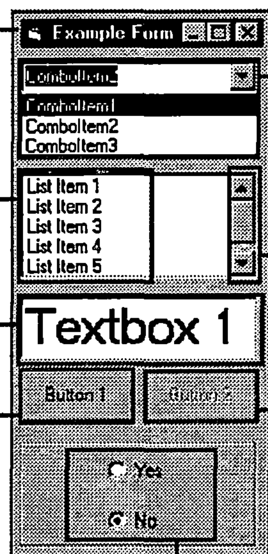
Figure 1. User Interface Component Reference.

Form - The Windows components are placed on a form. This is what the user sees and interacts with.

Listbox - Users pick from the list using the mouse.

Textbox - Used to input data from, and display data to, the user.

Button - Click the button with the mouse to activate or run certain portions of the program.



ComboBox - Similar to Listbox. The combobox's list portion is hidden when not in use. Users drop down the combobox's list to pick items using the mouse.

Scrollbar - Used to Scroll up and down when there are more list items than can be displayed.

This button is **Disabled**; The dimmed color means that the program needs more input before it will **Enable** this button.

Option Buttons - Provide the user a choice between several items.

Warehouse Connection Wizard

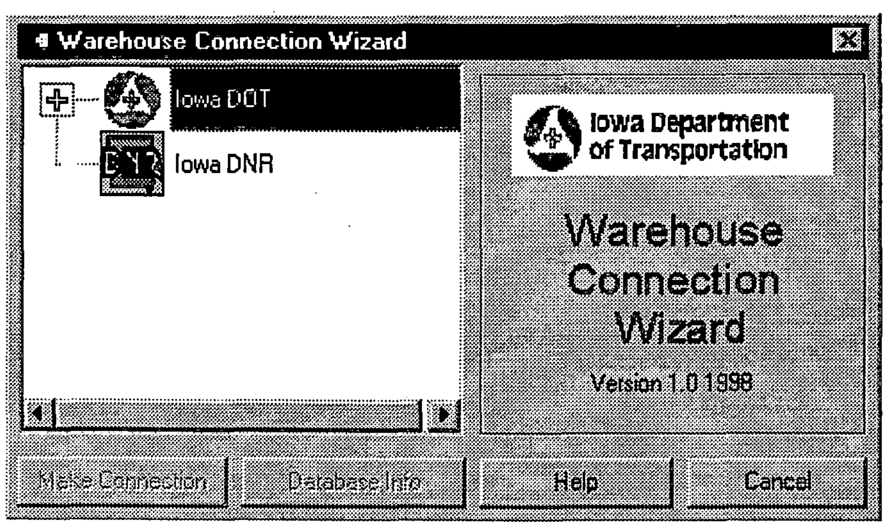
The Warehouse Connection Wizard provides users with access to Geomedia warehouses without requiring knowledge of warehouse location and type. Without the Warehouse Connection Wizard users must know the exact location of a warehouse, in addition to the type of storage format the warehouse is maintained. Certain warehouse types (i.e. MGE, MGSM) require special procedures to be followed in order to connect as a data warehouse. The Warehouse Connection Wizard was created to alleviate these problems by automating much of the connection procedure. Table 1 contains a comparison of each workflow required to connect to a warehouse using the traditional Geomedia method versus the Warehouse Connection Wizard.

Table 1. Workflow Comparison of Connection Methodologies.

Geomedia Methodology	Warehouse Connection Wizard
Warehouse>New Connection	IowaDOT>Connect to Warehouse
Specify Type of Connection	Specify Warehouse
Define Connection Name	Make Connection
Define Path to Warehouse File	
Define any Connection Filter	
Specify Whether Connection is Writable	
Make Connection	

In addition to automating the procedure, information regarding the contents of the warehouse can also be accessed using the Warehouse Connection Wizard. The basic interface is shown in Figure 2.

Figure 2. Warehouse Connection Wizard Basic Interface



Using the Warehouse Connection Wizard

The basic workflow for using the Warehouse Connection Wizard consists of:

- Activate Warehouse Connection Wizard from IowaDOT menu.
- Select warehouse to connect to.
- Click on the **Make Connection Button** to connect to warehouse.
- Use the Legend menu in Geomedia to add features from warehouse.

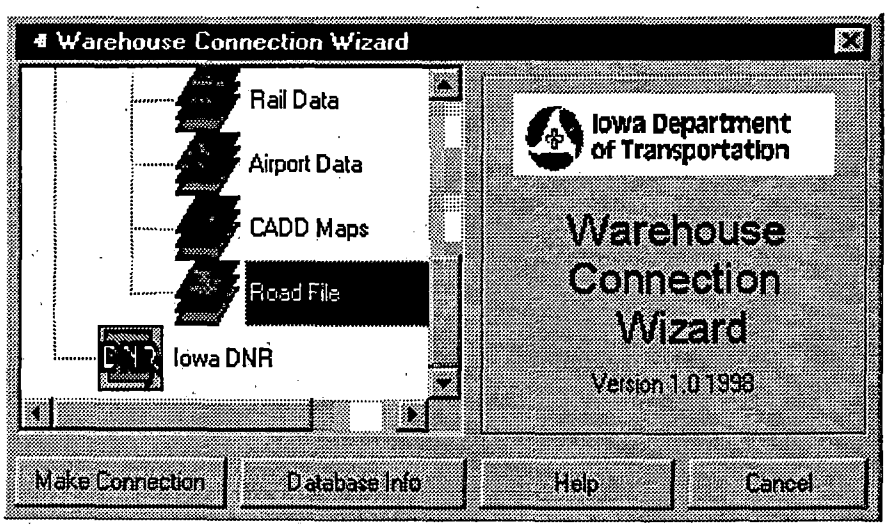
Activating Warehouse Connection Wizard in Geomedia

From within an active Geomedia Workspace choose **>IowaDOT>Connect to Warehouse** to activate the Warehouse Connection Wizard. The interface will appear in the middle of the screen. Each general connection category appears as an icon followed by a description.

Selecting a Warehouse for Connecting

Using the mouse, double-click on the name of a general category or its icon to reveal individual warehouse connections. Single-click on any warehouse name or its icon to select it for connection. Doing so will enable the **Make Connection Button** on the lower left corner of the interface. Figure 3 shows the Warehouse Connection Wizard interface with a warehouse selected for connection and the **Make Connection Button** enabled.

Figure 3. Selection of Warehouse for Connection



Making the Connection

Once a data warehouse is selected, clicking the **Make Connection Button** causes Geomedia to create the data warehouse connection. A connection will not be made to a warehouse already open in the existing Geoworkspace. The Warehouse Connection Wizard will deactivate when the connection is made.

Add feature classes from the warehouse to the map window following normal directions.

The Database Info Button

Once a data warehouse is selected, click the **Database Info Button** to view more information regarding the warehouse. Available information includes:

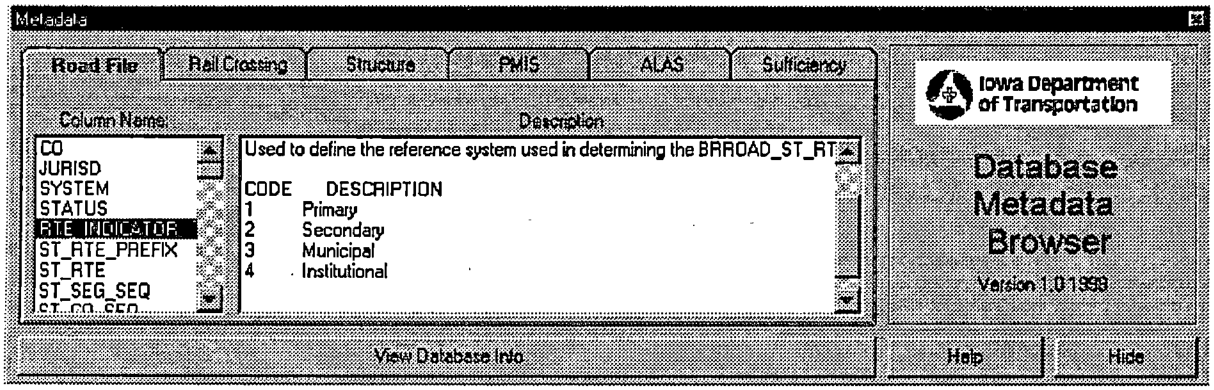
- What feature classes are available in this warehouse.
- When the warehouse was created.
- When individual feature classes were created.
- Who is responsible for maintaining the warehouse data.
- Any accuracy information as applicable.
- Other information as necessary.

Database Metadata Browser

The Database Metadata Browser allows users online access to database column information. The Database Metadata Browser tool was created to help users to determine what the name of a column in the database signifies or what a particular code in a column represents. The basic interface is shown in Figure 4.

> For example, the Road File column RTE_INDICATOR stands for 'ROUTE INDICATOR' and the number 3 represents 'MUNICIPAL'.

Figure 4. Database Metadata Browser Interface



Using the Database Metadata Browser

The basic workflow for using the Database Metadata Browser consists of:

- Activate Database Metadata Browser from IowaDOT menu.
- Select appropriate database tab.

Activating Database Metadata Browser in Geomedia

From within an active Geomedia Workspace choose **>IowaDOT>View Database Metadata** to activate the Database Metadata Browser. The interface will appear in the middle of the screen. The Database Metadata Browser is a floating toolbar and may remain open in standby mode as long as Geomedia is running.

Viewing Column Information for a Database

A single tab on the Database Metadata Browser interface represents each database table with column information available. A single-click on the appropriate tab allows the user to view information regarding a particular database. To change which column the **Description Textbox** is describing, single-click on any line in the **Column Name Listbox**.

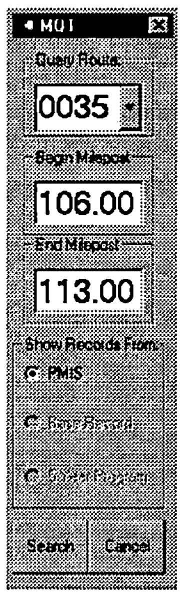
Milepost Query Tool

The Standard Query Language (SQL) query that must be written to select a series of segments referenced by milepost is rather involved. An example query written to select all the Pavement Sections between mileposts 106 and 113 on interstate routes 35 follows:

Select * from PMIS where ST_RTE = "0035" and BEG_MILE <= 113 and END_MILE >= 106

The Milepost Query Tool provides users the ability to easily select roadway sections referenced by milepost, without having to understand or learn the SQL commands necessary to run the query. The basic interface is shown in Figure 5.

Figure 5. Milepost Query Tool Interface



Using the Milepost Query Tool

The basic workflow for using the Milepost Query Tool consists of the following:

- Activate Milepost Query Tool from IowaDOT menu.
- Select the query route.
- Select the beginning and ending mileposts.
- Select the database to query.
- Execute the search query.

Activating Milepost Query Tool in Geomedia

From within an active Geomedia Workspace choose **>IowaDOT>Query Segments by Milepost** to activate the Milepost Query Tool. The interface will appear in the middle of the screen.

Selecting the Query Route

Users select the query route by clicking on the **Route Combobox** located near the top of the interface. All state primary system routes appear in the list. Users can type the route name directly or use the mouse to find the desired route. Use leading zeroes when entering the route number (see Figure 5).

Entering the Beginning and Ending Mileposts

To enter the beginning milepost, use the mouse to highlight the 000.00 in the **Begin Milepost Textboxt**. Users need not enter the decimal distance if the desired milepost is a whole number. For example, if the beginning milepost is 5, the user does not need to enter 5.00, just 5. Repeat this process to enter the ending milepost. Please note that the ending milepost must be greater than the beginning milepost for the query tool to allow the query to be executed.

To select the entire route, do not change any of the beginning or ending milepost information.

Selecting the Database to Query

Before a query can be executed a database must be selected. A list of DOT GIS databases referenced by milepost is located at the bottom of the interface (see Figure 5). Select one of these databases using the mouse to click the **Database Option Button** next to the database.

Executing the Database Query

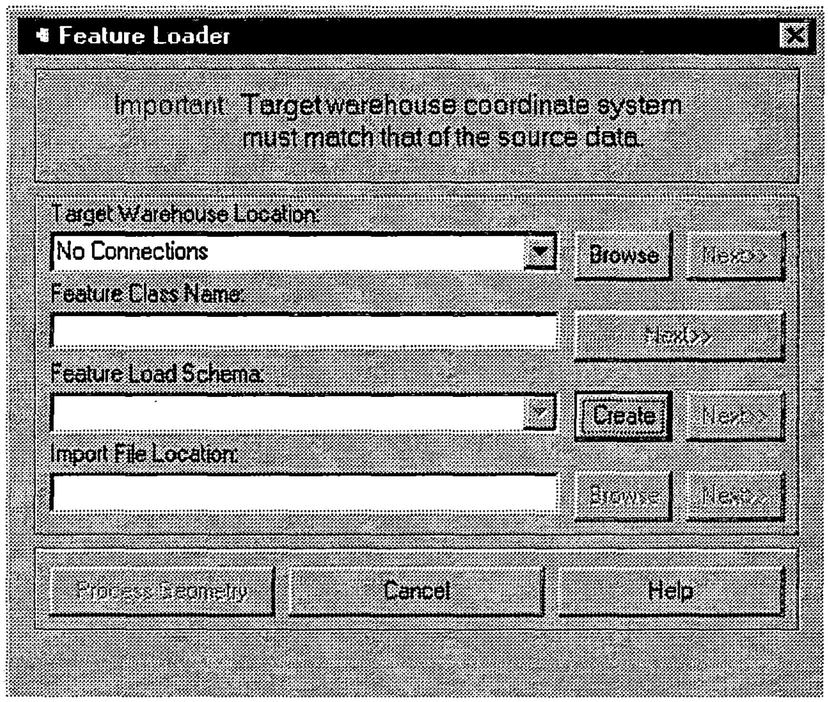
Once the user has selected a route to query, entered the beginning and ending mileposts, and chosen the database to query, the query may be executed by clicking the **Search Button** with the mouse.

The query will be performed and the results will be added as a new map layer in the Geoworkspace. The query may be saved with the Geoworkspace or inserted into an Access Warehouse following the appropriate Geomedia instructions.

Feature Loader

The Geomedia environment does not support the ability to import GPS and other feature data for display on a map. While not accessible to users, the Geomedia software does contain functionality to allow importing of geometry features. Feature Loader was written to access this functionality. The initial startup interface is shown in Figure 6.

Figure 6. Feature Loader Main Interface



Feature Loader processes point, line, or polygon features, along with associated attributes, stored in a text file, and imports these data into an Access Warehouse, which can be displayed as a legend entry in Geomedia. The format of the import text file is explained to the Feature Loader software using a Feature Schema file. The Feature Schema file is defined prior to importing using Feature Loader's Feature Schema Setup. Before any text file can be imported into Geomedia, a Feature Schema must exist to explain to the software how the text file is formatted. Once a Feature Schema is defined for a particular text file format, it can be used to import any text file stored in that format.

Using Feature Loader to Define a Feature Schema

A Feature Schema consists of two separate components:

- A Geometry Schema specifying the location of coordinate information in the Import Text File.

- A Database Schema specifying the location of any attribute information in the Import Text File.

The basic workflow for using Feature Loader to define a Feature Schema is as follows:

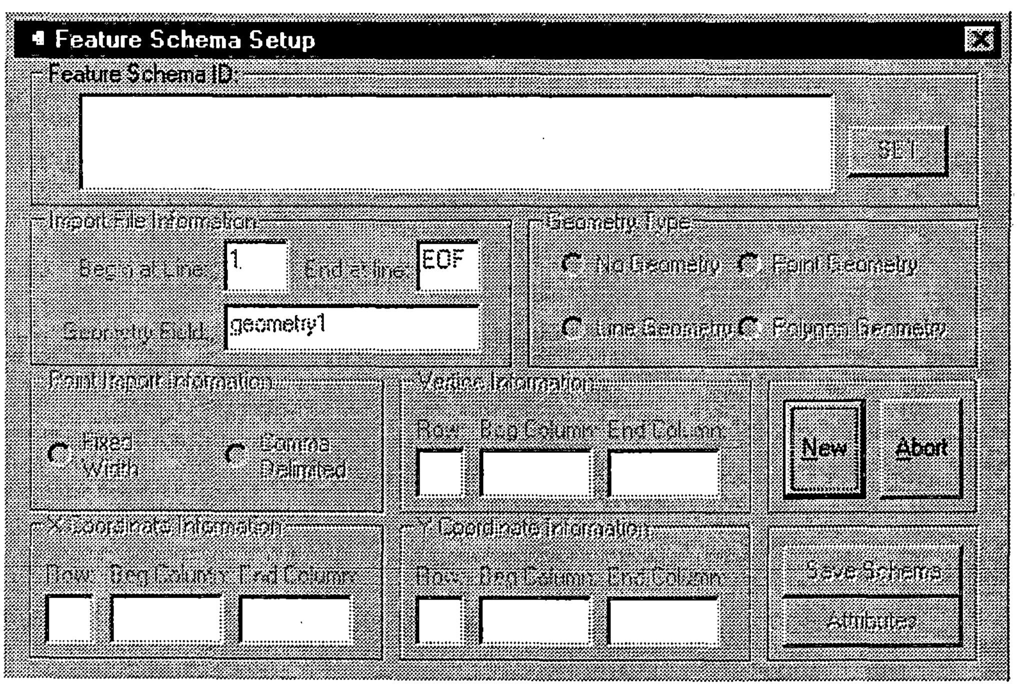
- Activate Feature Loader from the IowaDOT menu.
- Determine type of schema to create (point, line, or polygon).
- Create Feature Schema, using Feature Loader's Feature Schema Setup Interface, describing the format of the import text file.
- Save Feature Schema.

Creating the Feature Schema

To create a Feature Schema, activate Feature Loader in Geomedia by using **IowaDOT > Import Geometry From Text File** located on the Geomedia menu bar. The main Feature Loader screen will appear. To create a Feature Schema click the **Create Button** located halfway down the form (see Figure 6).

The Feature Schema Setup form is shown in Figure 7. A user cannot begin editing any part of the form until the **New Button** is clicked. Once the user clicks the **New Button**, the Feature Schema ID textbox will become editable. Enter a name for the new schema to be created. The name can be up to 50 characters in length and cannot contain spaces.

Figure 7. Feature Schema Setup Interface



Choose a name that describes the type of features that the schema will be used to create.

> For example, use PC_ALAS_Node_Schema to describe a schema for importing PC-ALAS node locations.

Defining the Geometry Schema

A schema describing line geometry contains different information than a schema describing point geometry. The Feature Schema Setup form contains input textboxes necessary for every type of geometry. For these reasons, not every textbox on the Feature Schema Setup form will be filled in. The software will direct the user to fill in the appropriate information by highlighting the required textboxes of the form, based on the type of geometry to be imported.

Specifying Geometry Type

Users specify the type of geometry to be imported by clicking on the appropriate geometry option button in the Geometry Type section of the Feature Schema Setup form. Clicking on one of these **Geometry Option Buttons** causes the appropriate textboxes on the remaining areas of the form to become active.

Point Import Information

For point geometry, the import text file can be fixed-width **or** comma-delimited. Users specify how the file is formatted by clicking on the appropriate option button in the Point Import Information section of the Feature Schema Setup.

Vertex Information

The row number and position of the information concerning the number of vertices a line or polygon contains is entered in the Vertex Information area of the form. This information is only applicable for line or polygon geometry.

X and Y Coordinate Information

Users input the row and position in the text file where information concerning the x and y coordinate information is located for each feature.

Saving the Geometry Schema

Once all the necessary inputs are entered for a particular geometry type, the **Save Schema Button** will become active. Clicking this button will save the schema for the geometry to the schema database. Additional attributes may now be defined for the geometry.

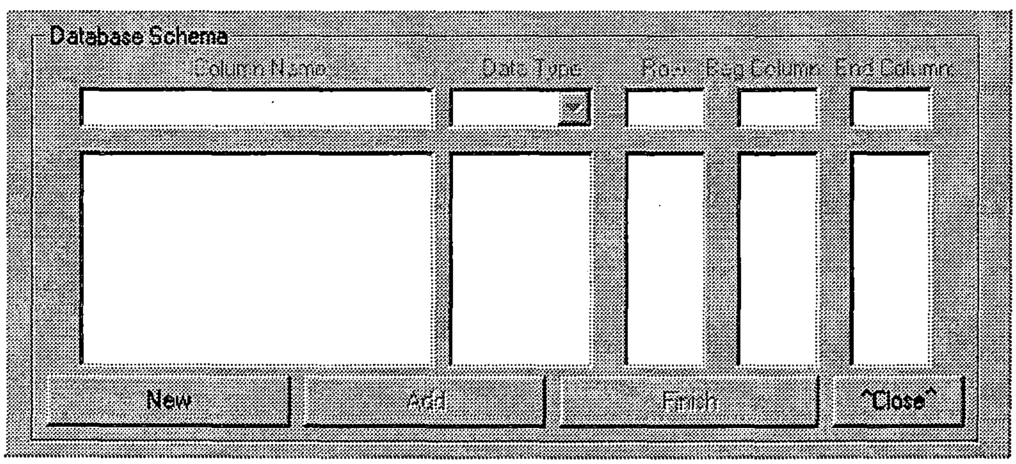
Defining the Database Schema

Feature Schema is also used to define the type and location of any additional attribute information contained in the Import Text File.

> Using the ALAS Node example, the Import Text File contains additional data such as the node, county, and township numbers for each node.

These additional data are specified using the Database Schema Setup activated by clicking the **Attributes Button**. The **Attributes Button** is enabled once the geometry schema is saved. Clicking the **Attributes Button** lowers the Database Schema form shown in Figure 8.

Figure 8. Database Schema Setup Interface



Entering Column Name Information

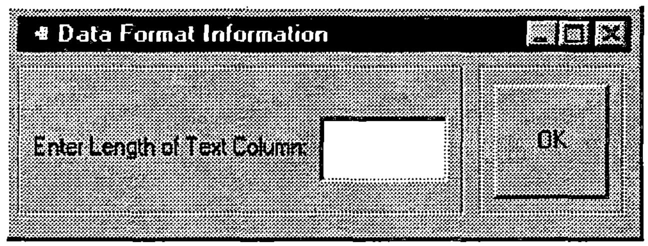
For each attribute that will accompany geometry, a corresponding column must exist in the warehouse database. Columns are defined by first clicking the **New Button** located at the lower left of the form.

Clicking the **New Button** enables the Column Name textbox for editing. Users enter the column name by clicking on the textbox and typing the name. Spaces should not be entered into the **Column Name Textbox.** Doing so will cause undesired results in code execution. Column names can be up to 50 characters in length.

Entering Column Data Type Information

Users must specify the type of data that each column will contain. This is done using the **Data Type Combobox**. The **Data Type Combobox** lists the available column data types. Choosing the 'Text' data type will launch the Data Format Information form. This form will prompt the user for further input as to the number of text characters the column can hold. Figure 9 shows the Data Format Information form.

Figure 9. Text Format Input Form.



Entering Column Data Position Information

For each column, the user must enter the row number, beginning position, and the ending position of the data to place in the column. For comma-delimited point geometry files, the column row, beginning, and ending positions cannot be entered. Instead the user must input the columns in the order they are delimited in the text file. Before comma-delimited point geometry is processed, the user will be prompted to specify which columns contain the x and y coordinate information.

Adding the Column Schema to the Geometry Schema Database

Once the appropriate column information is entered on the form, the **Add Button** will become enabled. Clicking the **Add Button** will append the column information to the Database Schema. The information previously entered will appear in the listboxes at the bottom of the form for reference. The **Column Data Textboxes** at the top of the form will be cleared. Add additional column information by repeating the previous process.

Once all columns are added, click the **Finish Button** to save the entire schema, which now consists of a Geometry Schema and a Database Schema. These two schemas comprise the Feature Schema.

Once the schema is saved it is available for importing the text files defined by the schema. Importing the data is described in the next section.

Importing Geometry Using Feature Loader

Prior to importing any geometry from a text file into Geomedia, the following conditions must exist:

- A valid schema must exist that defines the format of the import text file. (See previous section on creating an import schema.)
- A warehouse must exist that can store the imported data. The warehouse must have a Warehouse Coordinate System matching the coordinated system of the import data file.

Follow user instructions listed in Geomedia Help for defining the proper coordinate system of the target warehouse.

If these conditions are met, Geometry is imported using the following basic workflow:

- Activate Feature Loader from the IowaDOT menu.
- Determine type of geometry to create (point, line, or polygon).
- Set target warehouse for storing new geometry.
- Specify Feature Schema to describe format of import text data.
- Specify the name of the new feature to add to the warehouse.
- Process geometry import file.

Setting the Target Warehouse

Set the target warehouse by choosing an already open warehouse connection from the Target Warehouse combobox, or if no connections are available, the combobox will display "NO CONNECTIONS". If no connections are available, click the **Browse Button** to open a warehouse connection. The warehouse must have read/write access in order for the software to import the geometry.

Setting the Feature Name

The new feature to be imported must be given a name unique to the target warehouse. Feature Loader will notify the user if the name entered is not unique.

The name cannot contain spaces. Using spaces will produce an error in the software.

Once an acceptable name is entered, the **Next Button** will enable. Click the **Next Button** to proceed to the next section of the form.

Setting the Feature Load Schema

All geometry that will be imported from a text file must have a valid schema defining how to import the text data. All available schemas are listed in the Feature Load Schema combobox. Click on the appropriate schema to set the import schema. Doing so will enable the **Next Button**. Click the **Next Button** to proceed to the Import File Section of the interface.

Setting the Import File Location

Set the import file location by clicking the **Browse Button** next to the **Import File Textbox**. Once the file location is specified, the **Next Button** will enable. Click the **Next Button** to enable the **Process Geometry Button**.

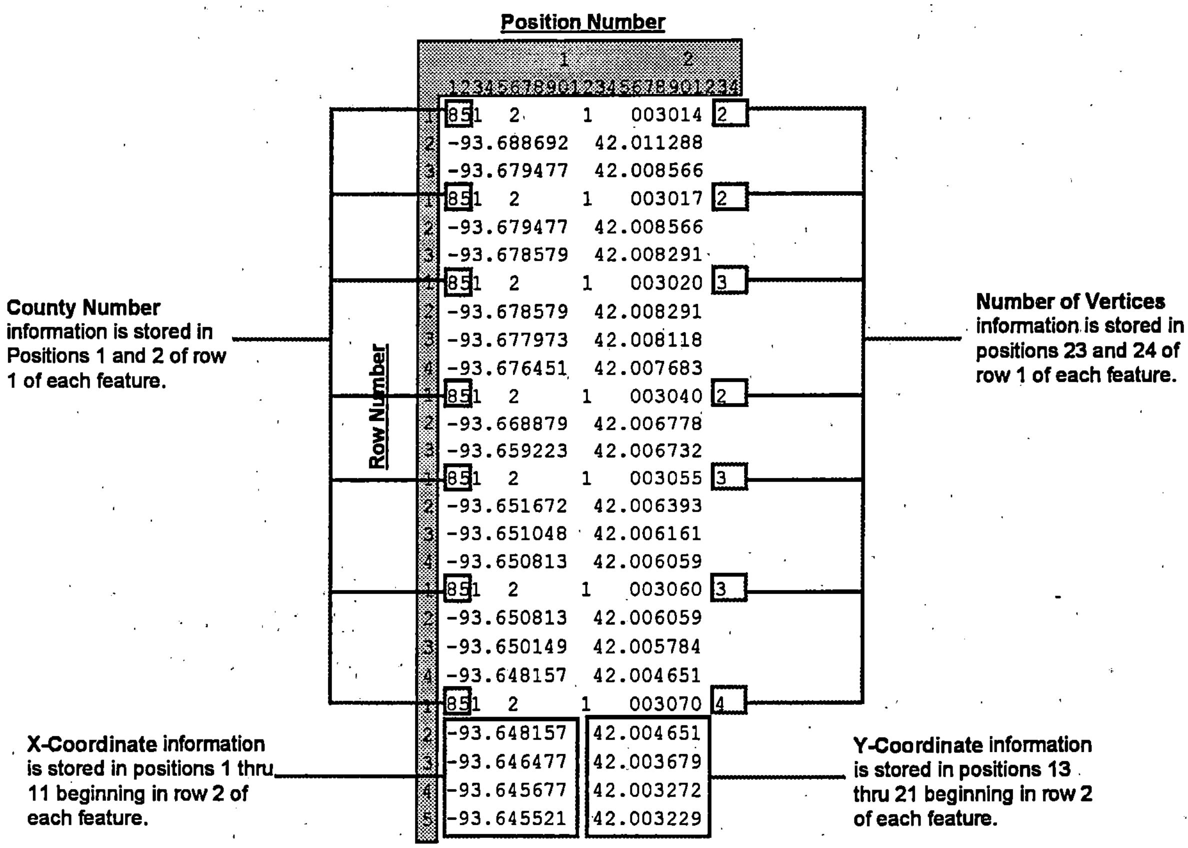
Processing the Geometry Text File

To process the geometry, click the **Process Geometry Button** located at the bottom of the Feature Loader interface. A progress bar will show geometry import progress. When the file is finished, add the new feature to the map legend following Geomedia's instructions for adding features to the map.

Example 1 – Schema Setup and Importation of Line Features

This example will illustrate how to setup a schema and import line features from a text file. The text file for this exercise comes from an MGE ASCII Unload of Iowa DOT primary road data. Following the previously discussed workflow, a Feature Schema must be created to describe the format of the Import Text File to the Feature Loader import software. A sample from the text file appears in Figure 10.

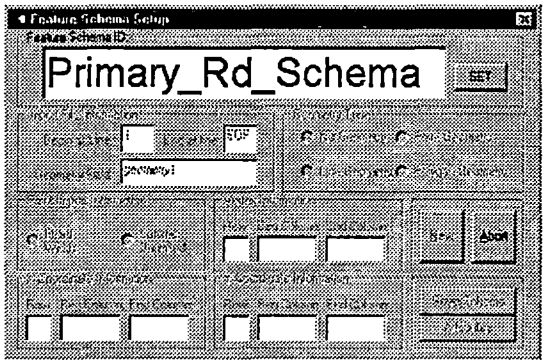
Figure 10. Import Text File Format



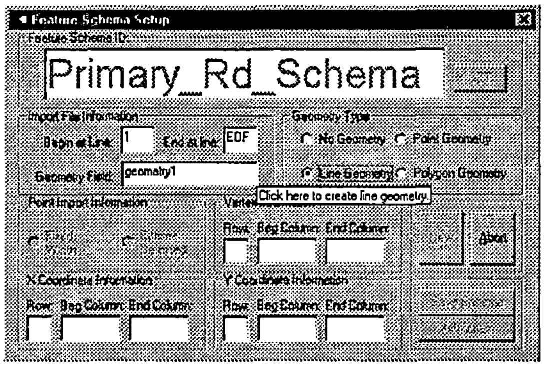
Creating a Feature Schema

After starting up Feature Loader in Geomedia, click the **Create Button** to activate the Feature Schema Setup screen.

Step 1. The first step is to define the schema name. Click the **New Button** and Enter 'Primary_Rd_Schema' into the **Schema Name Textbox**. When finished, click the **Set Button**.

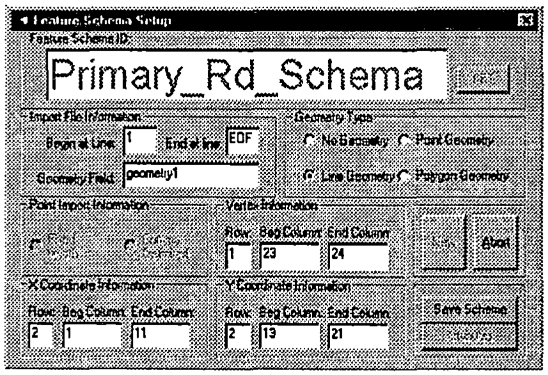


Step 2. Select the type of geometry the schema file will define. Click the **Line Geometry Option Button** in the Geometry Type box. Doing so will cause the appropriate textboxes needed for inputting line Geometry Schema information to enable.

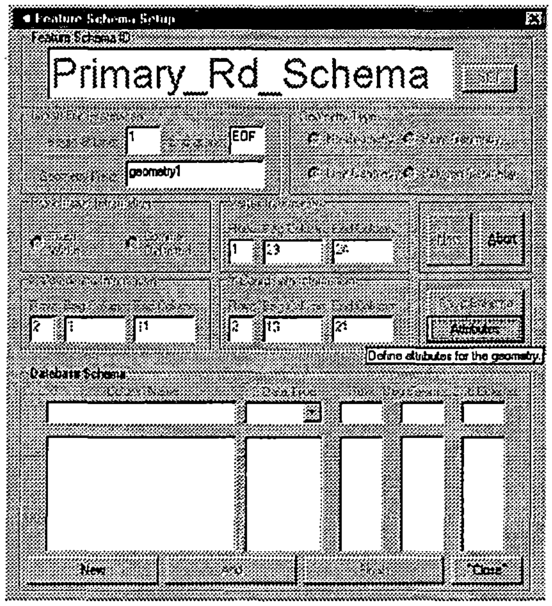


Step 3. Fill out the Vertex Information box, specifying where row and column positions are located in the text file.

In the text file, the number of vertices is located at positions 23 and 24. In addition, the x and y coordinate information begins on row 2 of the text file, with the x coordinate extending from position 1 to position 11 and the y coordinate extending from positions 13 to 21. Once all the necessary boxes are filled the **Save Schema Button** will enable.

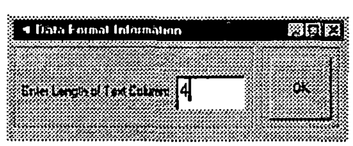


Step 4. Save the Geometry Schema and proceed to add feature attributes by clicking the **Save Schema Button**. Doing so will enable the **Attributes Button**. The Database Schema dropdown form will lower when the **Attributes Button** is clicked (see the following figure).



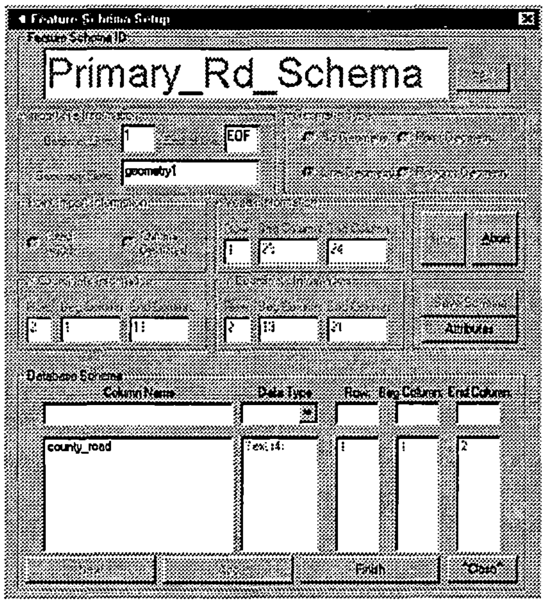
For this example, the text file contains additional county and route information along with the geometry coordinate information. The county and route information must be specified in the Database Schema dropdown form in order for the county and route column to be setup in the database. To add the county column, first click the **New Button** in the lower left corner of the dropdown form.

A blinking cursor will appear over the Column Name textbox. Enter 'County_Number' in this area. The data type of the county number column is to be a text string of length 4 characters. Use the **Data Type Combobox** to set the column type to 'Text'. The Data Format Information form will appear to input the length of the text field. Enter 4 here to represent 4 characters.



Enter the row number of the data along with the beginning and ending column positions in the appropriate textboxes. For this example, the county number information is located in columns 1 and 2 of row 1, therefore, '1', '2', and '1' need to be entered in the respective textboxes.

Once all the required textboxes have data, the **Add Button** will enable. Click the **Add Button** to add the county field to the Database Schema. The data added to the schema will appear in the listboxes below the Column Input line.



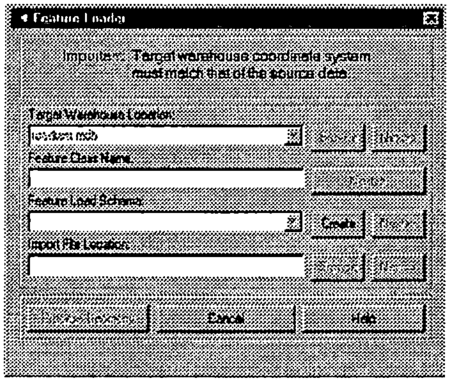
Repeat the above process to add a column called 'Route' having a length of 6 characters. The row number for the route data is 1, and the positions range from 16 to 19. After clicking the **Add Button** to add the final column, click the **Finish Button** to complete the Database Schema.

This completes the schema creation component of Example 1.

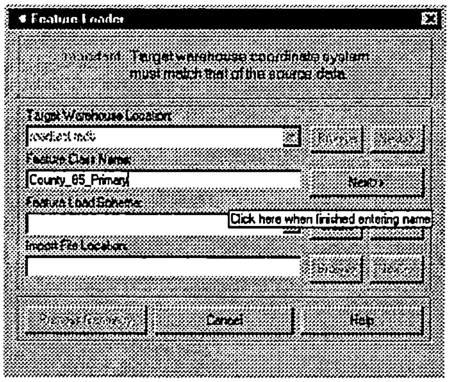
Importing Geometry Using an Existing Feature Schema

Start Feature Loader in Geomedia.

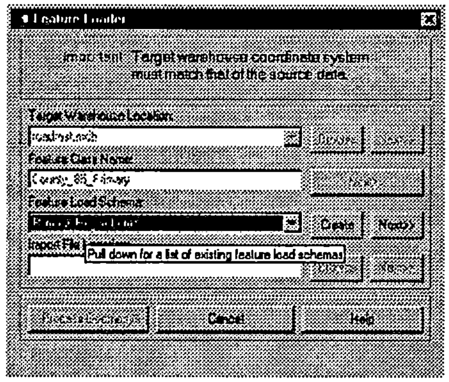
Step 1. Set the target warehouse to receive the import data. Click the **Browse Button** to set the target warehouse to 'C:\warehouses\roadtest.mdb'.



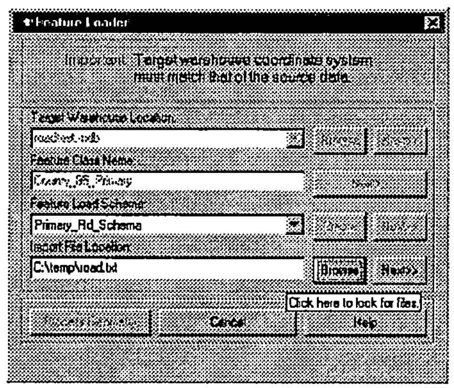
Step 2. Enter a name for the new Feature Class. In the textbox type 'County_85_Primary'. Click the **Next Button** when finished.



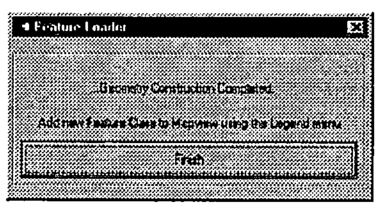
Step 3. Specify which schema to use for importing the feature. Click the **Feature Load Schema Combobox** and set the schema to 'Primary_Rd_Schema'. When finished, click the **Next Button**.



Step 4. Specify the location of the Import Text File. Click the **Browse Button** to set the Import Text File location to 'C:\temp\road.txt'. When finished click the **Next Button**.



Step 5. Process the Import Text File by clicking the **Process Geometry Button**. When the processing is finished, the following form appears:



This completes the Feature Load component of Example 1.

Example 2 – Schema Setup and Importation oF Point features

This example will illustrate how to setup a schema and import point features from a text file. The text file for this exercise comes from an Mapinfo comma-delimited ASCII export of Iowa DOT ALAS Node Data. Following the previously discussed workflow, a Feature Schema must be created to describe the format of the Import Text File to the Feature Loader import software. A sample from the text file appears in Figure 11.

Figure 11. Import Text File Format

ALAS Node Number information is stored in Position 3.

Township Number information is stored in Position 2.

X-Coordinate information is stored in Position 4.

County Number information is stored in Position 1.

Y-Coordinate information is stored in Position 5.

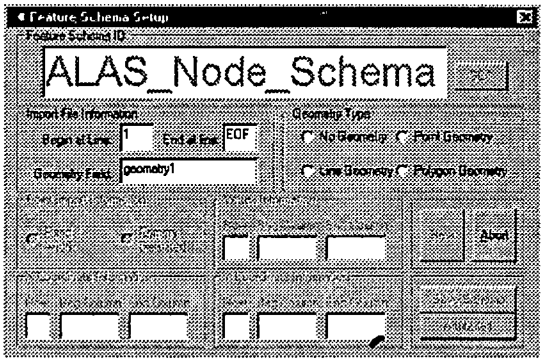
```
21,23,2006,-95.1459,43.0141
21,11,117,-95.3675,42.9098
21,11,181,-95.2887,42.9099
21,11,881,-95.2892,42.9172
21,11,1701,-95.3879,42.9238
21,11,3249,-95.3282,42.9386
21,11,3324,-95.3578,42.9398
21,11,3333,-95.348,42.9397
21,11,3401,-95.3879,42.9388
21,11,3824,-95.3579,42.9466
21,11,4910,-95.3773,42.9536
21,11,4917,-95.3675,42.954
21,11,4933,-95.348,42.9542
21,11,5909,-95.3814,42.9618
21,11,6301,-95.388,42.9652
21,11,6517,-95.3673,42.9686
21,11,6533,-95.3485,42.9688
21,11,6549,-95.3289,42.9687
21,11,6565,-95.309,42.9685
21,11,6581,-95.2893,42.9682
21,11,6717,-95.3673,42.9712
21,11,8101,-95.388,42.9821
21,11,8117,-95.3673,42.983
```

Note the difference between **Fixed-Width** (figure 10,p.14) and **Comma-Delimited**. Position information can change from line to line in a comma-delimited text format.

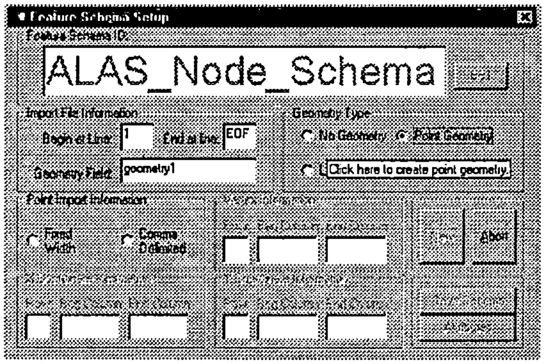
Creating the Feature Schema

After starting Feature Loader in Geomedia, click the **Create Button** to activate the Feature Schema Setup screen.

Step 1. The first step is to define the schema name. Click the **New Button** and Enter 'ALAS_Node_Schema' into the **Schema Name Textbox**. When finished, click the **Set Button**.

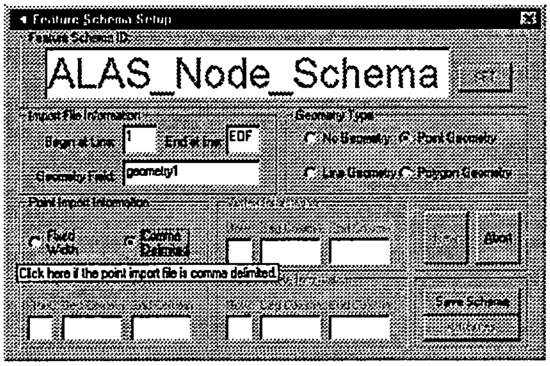


Step 2. Select the type of geometry the schema file will define. Click the **Point Geometry Option Button** in the Geometry Type box. Doing so will cause the appropriate textboxes, needed for inputting point geometry schema information, to enable.



Step 3. Click the appropriate option button in the Point Import Information box. Click the **Comma-Delimited Option Button**. Doing so will cause the **Save Schema Button** to enable.

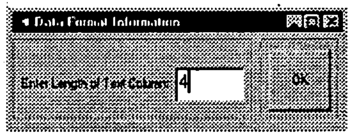
The coordinate information for a comma-delimited Import Text File is interpreted at processing time. Because of this, the X-Coordinate Information box and the Y-Coordinate Information box will not be editable, as this information is not needed. When the Import Text File is processed, the user will be prompted to specify which column in the database contains the X-Coordinate Information and which column contains the Y-Coordinate Information. This will be demonstrated in part 2 of this example.



Step 4. Save the Geometry Schema and proceed to add feature attributes by clicking the **Save Schema Button**. Doing so will enable the **Attributes Button**. The Database Schema dropdown form will lower when the **Attributes Button** is clicked.

For this example, the text file contains additional county, township, and node information along with the point geometry coordinate information. This information must be specified in the Database Schema dropdown form in order for it to be setup in the database. To add the county column, first click the **New Button** in the lower left corner of the dropdown form.

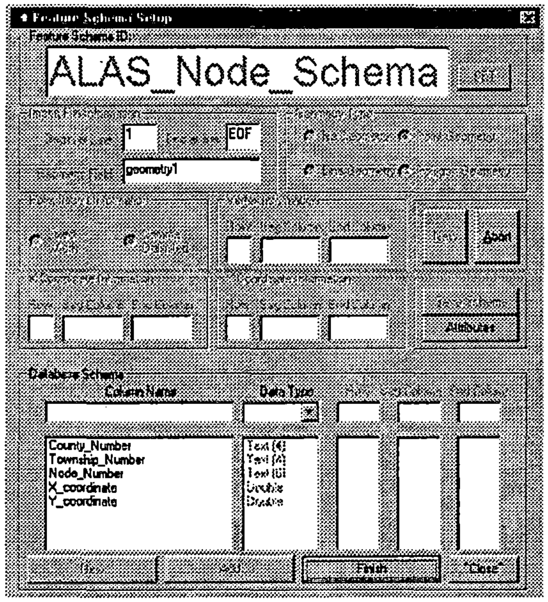
A blinking cursor will appear over the Column Name textbox. Enter 'County_Number' in this area. The data type of the county number column is to be a text string of length 4 characters. Use the **Data Type Combobox** to set the column type to 'Text'. The Data Format Information form will appear to input the length of the text field. Enter 4 here to represent 4 characters.



Because the Import Text File is comma-delimited, the row and column-position textboxes do not need to be filled in. They will not be editable.

Once all the required textboxes have data, the **Add Button** will enable. Click the **Add Button** to add the county field to the Database Schema. The data added to the schema will appear in the listboxes below the Column Input line.

Repeat the above process to add a 'Text' column called 'Township_Number' having a length of 4 characters, a 'Text' column called 'Node_Number having length of 6 characters, a 'Double' column called X_coordinate, and a 'Double' column called Y_coordinate. After clicking the **Add Button** to add the final column, click the **Finish Button** to complete the Database Schema. The Database Schema should resemble the following figure.

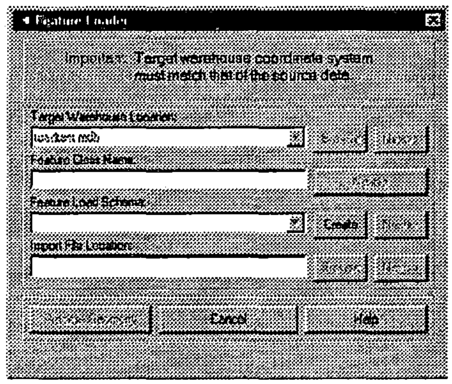


This completes the schema creation component of Example 2.

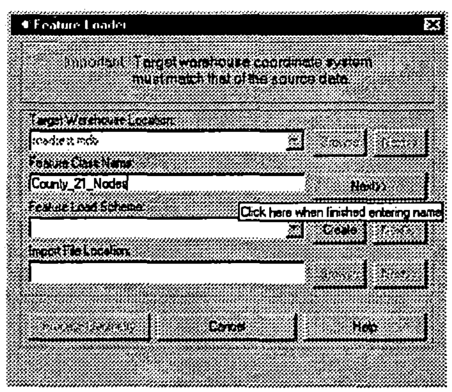
Importing Geometry Using an Existing Feature Schema

Start Feature Loader in Geomedia.

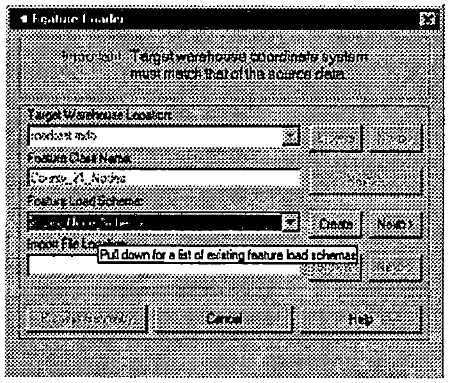
Step 1. Set the target warehouse to receive the import data. Click the **Browse Button** to set the target warehouse to 'C:\warehouses\roadtest.mdb'.



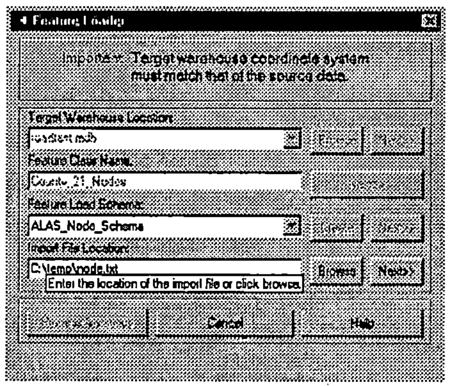
Step 2. Enter a name for the new Feature Class. In the textbox type 'County_21_Nodes'. Click the **Next Button** when finished.



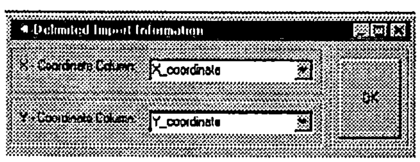
Step 3. Specify which schema to use for importing the feature. Click the **Feature Load Schema Combobox** and set the schema to 'ALAS_Node_Schema'. When finished, click the **Next Button**.



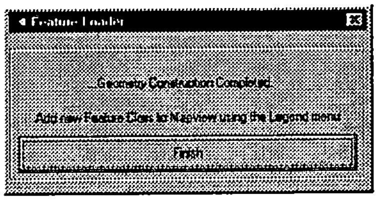
Step 4. Specify the location of the Import Text File. Click the **Browse Button** to set the Import Text File location to 'C:\temp\node.txt'. When finished click the **Next Button**.



Step 5. Specify which columns in the comma-delimited Import Text File contain the X and Y Coordinate Information. Click on the **X-Coordinate Column Combobox** and specify 'X_Coordinate'. Click on the **Y-Coordinate Column Combobox** and specify 'Y_Coordinate'. When finished click the **OK Button**.



Step 6. Process the Import Text File by clicking the **Process Geometry Button**. When the processing is finished, the following form appears:

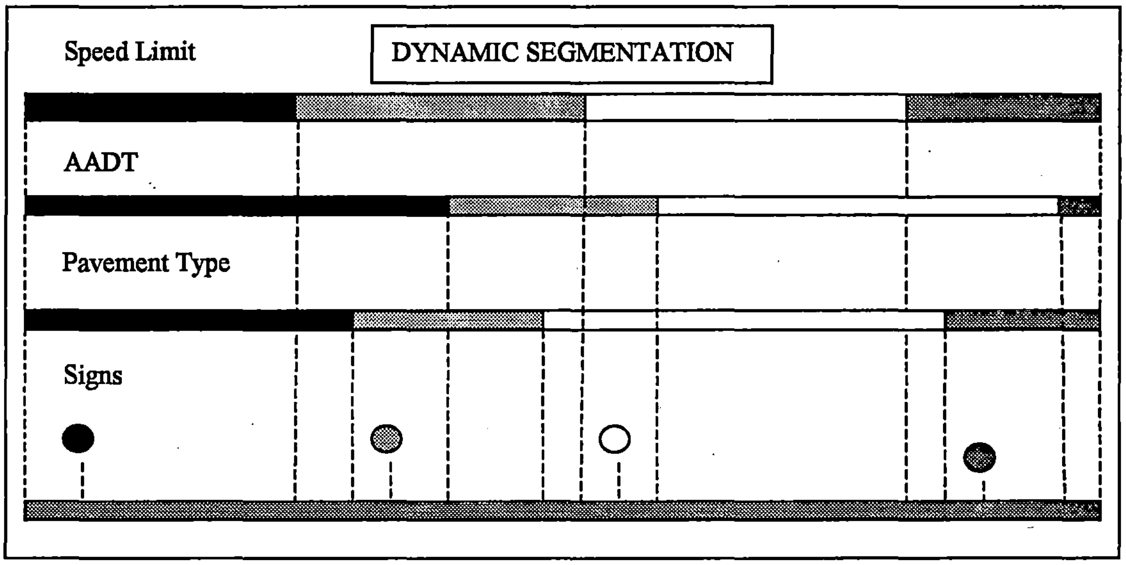


This completes the Feature Load component of Example 2.

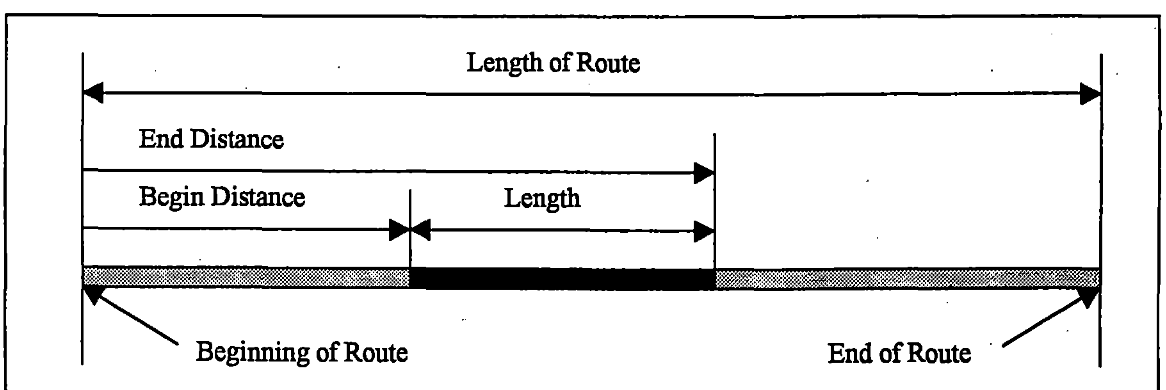
Querying Techniques: Linear Network & Spatial Queries

Linear Network Queries

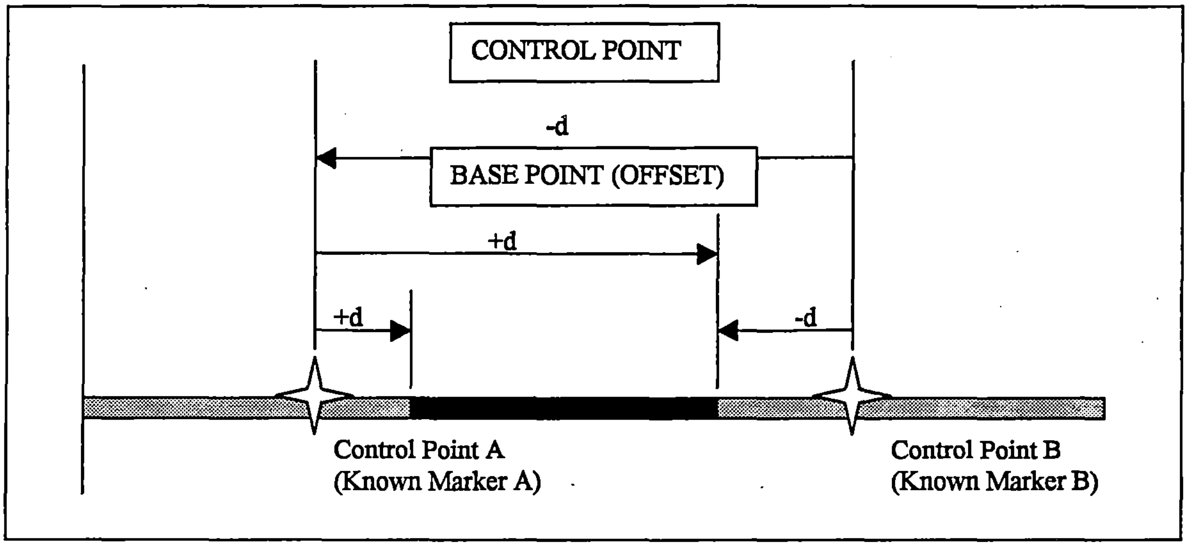
Linear network queries are performed through the use of dynamic segmentation. Dynamic segmentation is the geographic overlay and display of attributes describing conditions along a linearly referenced network. (Intergraph Corp.) Dynamic segmentation can accommodate multiple attribute tables, describing a highway network, without requiring duplication of network geometry or data. Only a single, graphic representation of the highway network is required.



The locations of attribute records along the highway network are identified using a linear referencing method. Components of a linear referencing method include identification of a route organization scheme and measurement of a distance and direction from a known point. Common linear referencing methods are base point (offset) and control point. The base point (offset) method references all locations based on their distance (along a route) from the route origin. Linear features located longitudinally along a route may be referenced using the begin and end distances from the route origin or begin distance from the origin and length.

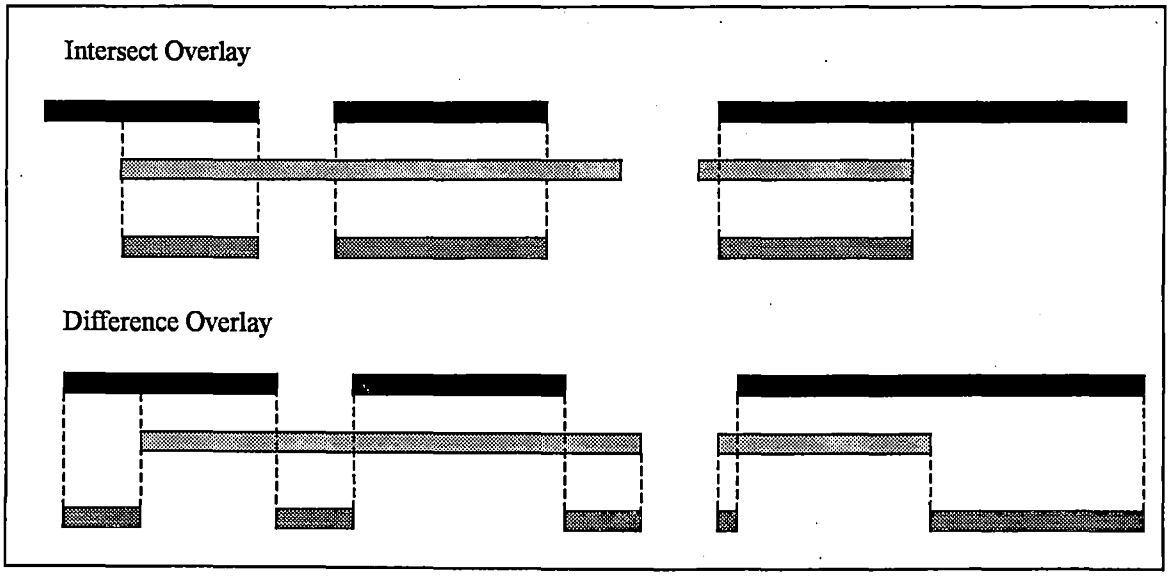


The control point method references all locations based on known locations (markers) along a route, such as milepost signs. Positive or negative offsets from these known markers may be used to reference locations.



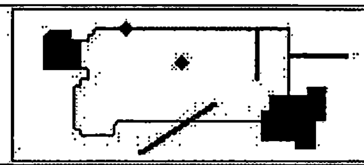
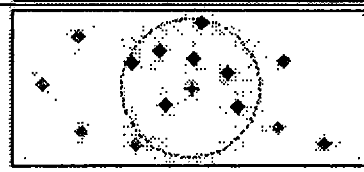
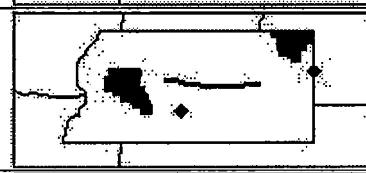
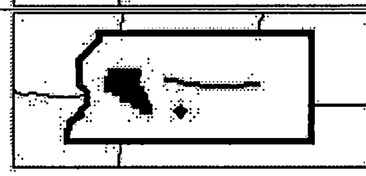
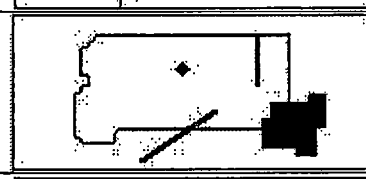
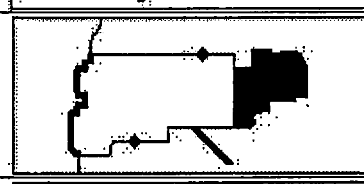
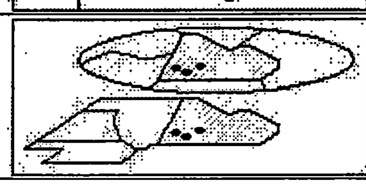
The spatial nature of GIS also enables the use of spatial referencing methods to identify the location of attribute data. In other words, coordinates identify the location of a point or linear extent along a highway. These coordinates may be either geographic (i.e. longitude, latitude) or projected (e.g. State Plane).

Search conditions for a linear network query are defined by combining sets of segments in attribute tables with overlay operators. The results of a linear network query are displayed as point or linear segments along the appropriate network linear feature.



Spatial Queries

A spatial query defines the relationship between two feature classes using a spatial operator, such as:

Touch returns features that touch the defined features in any way—meeting, overlapping, containing, or being contained by.	
Are within distance of returns features having any part located within the specified distance of the defined features. If either the starting or ending point of a linear feature, for example, falls within the specified distance, it will be returned.	
Contain returns features that surround defined features. Contained features can touch but not overlap the borders of the surrounding features. Points cannot contain other features.	
Are contained by returns features that fall completely within the defined features. Contained features can touch but not overlap the borders of the surrounding features.	
Entirely contain returns features that surround defined features. Contained features cannot touch or overlap the borders of the surrounding features. Points cannot entirely contain other features.	
Are entirely contained by returns features that fall completely within the defined features. Contained features cannot touch or overlap the borders of the surrounding features.	
Overlap returns features that overlap the defined features.	
Meet returns features that fall next to the defined features, touching without overlapping	
Are spatially equal returns features that occupy the same space and location. Features must be of the same type to be spatially equal.	

(Intergraph Corp.)

Digital Orthophoto Concepts

A digital orthophoto is a rasterized (scanned) aerial photograph, which is fully rectified to remove all of the distortions that occur in the original image. These distortions include pitch and roll of the aircraft, the radial distortion from the camera lens and the image displacement from the topography. The removal of the distortion results in the imagery becoming a true scale representation of the ground and can be used in a computerized system for measurements of length, area and azimuth.

Over the last few years, digital orthophotography has become more and accepted as a base map for geographic information systems for a wide variety of users. Indeed, this is one of the major advantages of digital orthophotos in a GIS environment. Vector map data are interpreted according to the specifications of the primary user, and are usually limited to the specific interests of that user or, alternatively, constrained by economics.

With digital orthophotos, all of the information that is on the original photograph is on the rectified image and is located in its true position. This allows multiple users with different interests to view, interpret, analyze and extract information for their specific use.

Aerial Photo Acquisition

Traditional aerial mapping photography is acquired in a vertical format using very specialized cameras and lenses. Mounted in gyro stabilized mounts, these cameras are pointed straight down at the surface of the earth (usually from aircraft) and record their images in flight lines. Within the flight line, each successive photo overlaps the previous image frame by between 60% and 80%. The overlap area between the two successive frames allows for stereo (3-D) viewing of the area in common and the subsequent collection of the digital elevation model (DEM). Where more than one flight line is required to cover the geographic area of interest, additional flight lines are flown with between 20% and 30% duplication (sidelap) between flight lines. This overlapping between flight lines does not allow stereo viewing between flight lines or DEM collection. Its sole purpose is to assure that there are no gaps, often called "data holidays" in the target area.

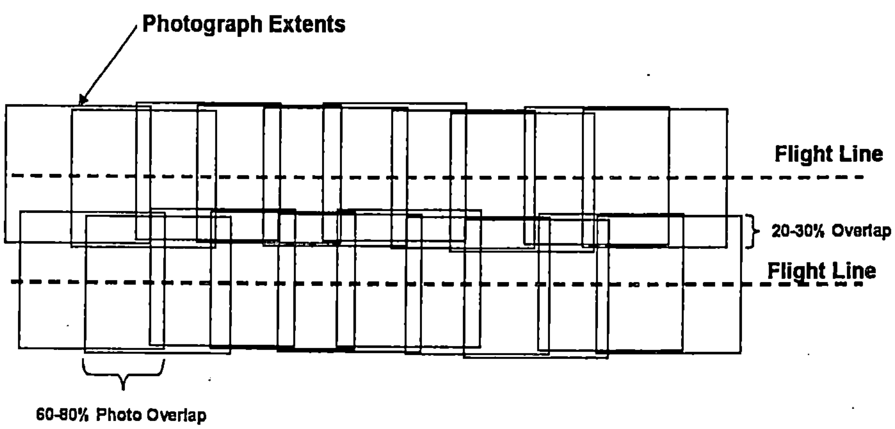


Figure 1 Aerial flight line overlaps

Each individual aerial photo is 9 inches square. On the sides of each frame (and on some cameras in the corners) are calibration points called fiducial marks. By drawing lines between opposing fiducial marks the intersection of two lines will define the center of the photograph. This point is called the principal point. If the photograph is a true vertical photo, this point also represents the point on the ground directly beneath the camera at the time of exposure. This point is called the *nadir*. Figure 2 illustrates the location of the fiducial marks, principal point and nadir for a true vertical image.

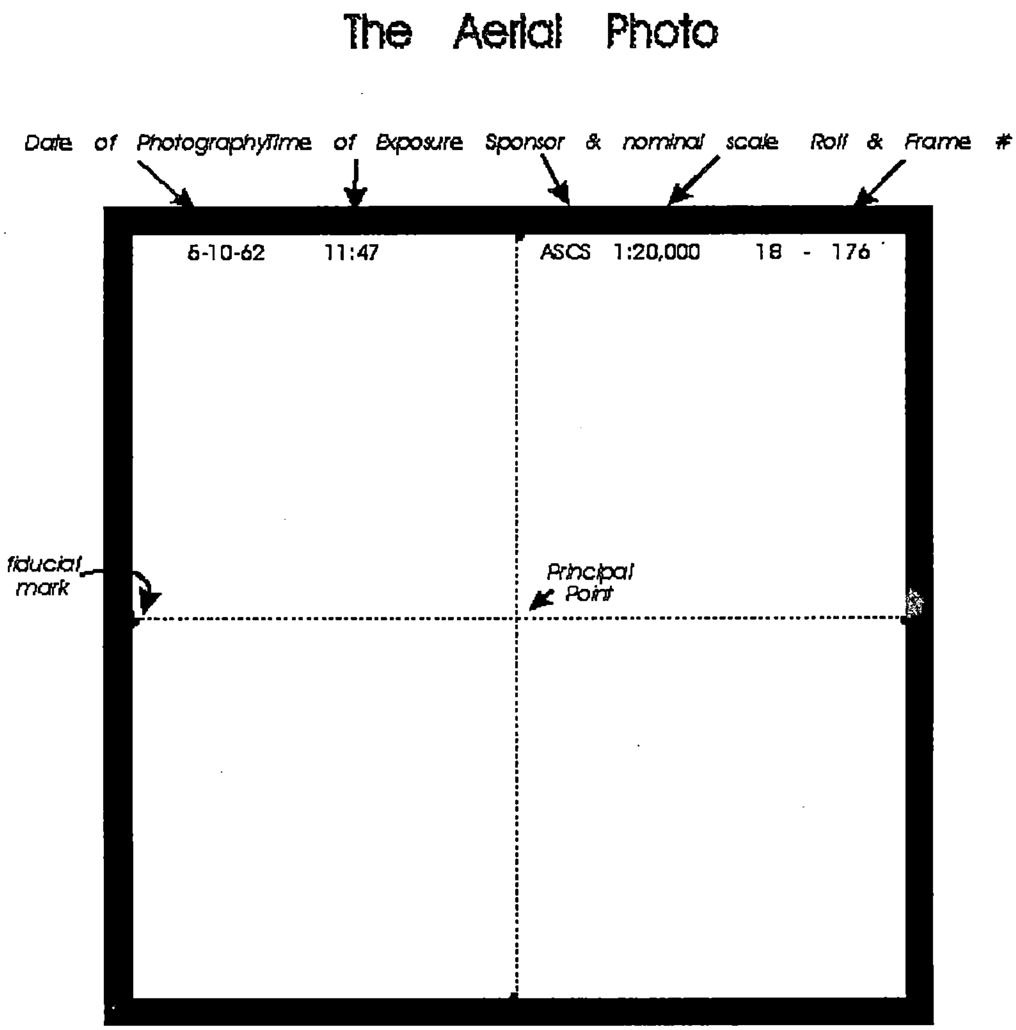


Figure 2 Aerial Photo Characteristics

Scale Differences

Scale of the imagery will vary across the photo in proportion to the height of the camera above the ground. Using the center of the photo as a base reference point, terrain that is at a lower elevation (further from the camera) will be represented at a smaller scale and terrain at a higher elevation will be imaged at a larger scale. Figure 3 illustrates this fact and shows the simple geometry and similar triangles used to make this calculation. In the construction of the orthophoto all fluctuations in scale are removed and the image is presented constant scale.

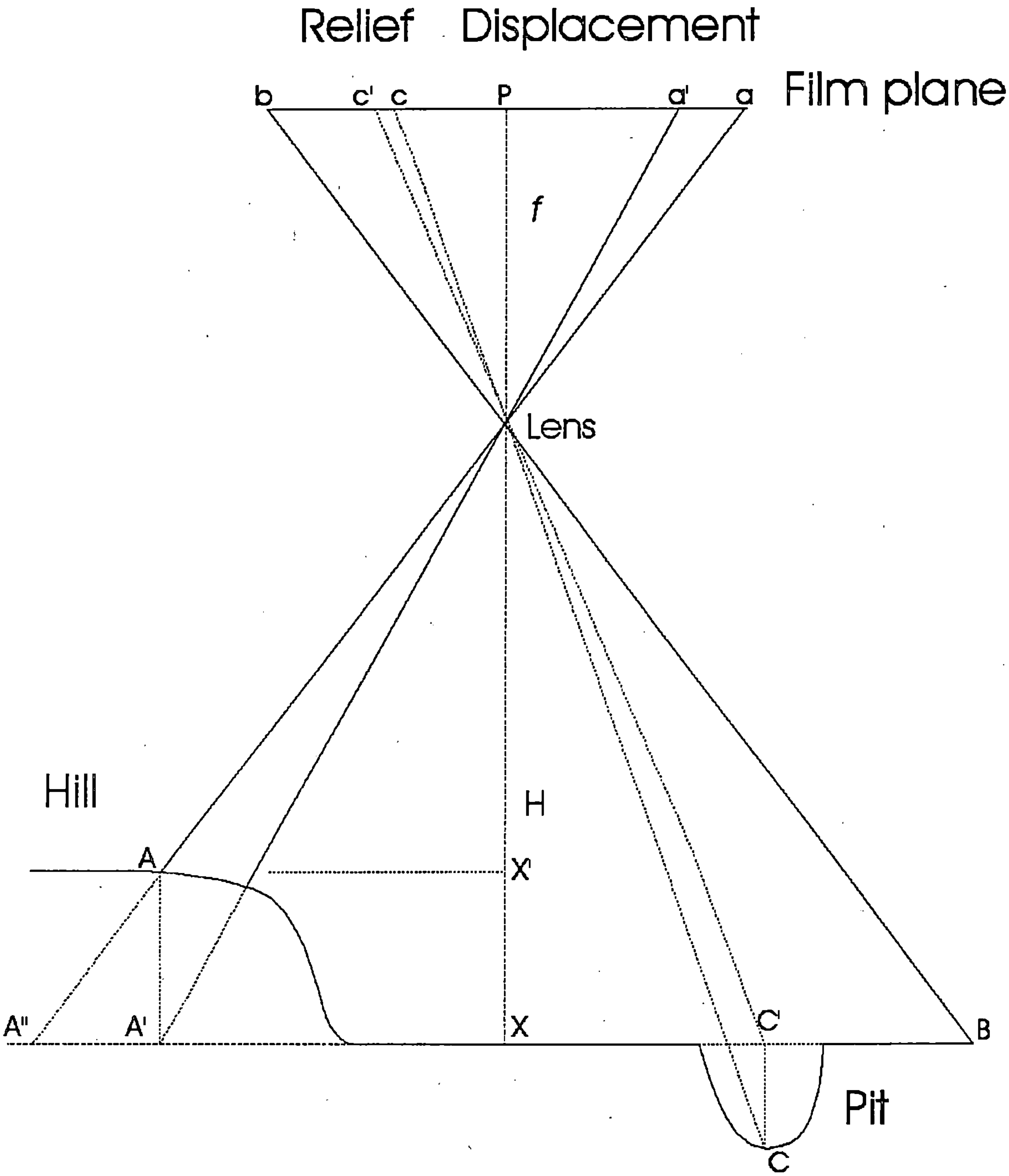


Figure 3 Ground Elevation Displacement on Film

Scale differences are also introduced due to the pitch and roll of the aircraft. Figure 4 shows how the assumed level plane shown in Figure 3 is always slightly tilted due to the movement of the aircraft.

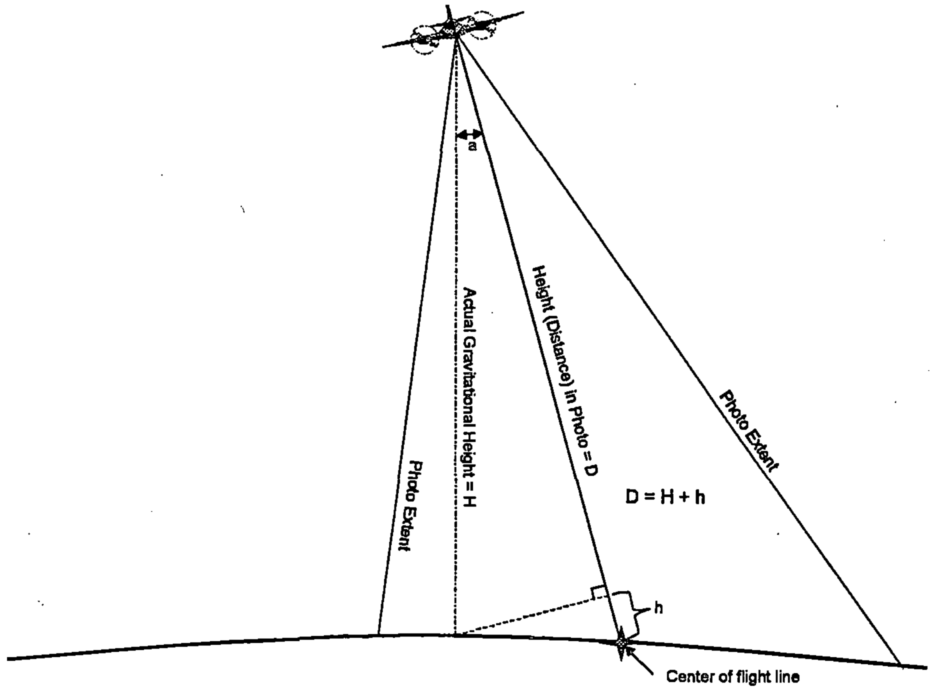


Figure 4 Exaggerated example of distortion due to aircraft tilt

The distortion from aircraft tilt can be caused by wind, pilot corrections to maintain a line, and many other phenomenon. In rugged terrain with large elevation changes, this distortion may be minimal in comparison to the relief displacement, but in flat topography this distortion may be just as significant as the relief displacement.

Relief Displacement

Relief displacement is a distortion that affects the spatial accuracy of the image. Simply stated, points that are higher than the *nadir* are displaced outward from the center of the photograph and points that are lower in elevation are displace inward from their true position. Referring again to Figure 2 the geometric displacement of both a hill and a pit in relation to the nadir are illustrated.

Relief displacement of the terrain is removed during the orthophoto development, thus the hills and valleys will appear in their true location. Relief displacement of flagpoles, buildings, trees and other similar features will remain on the image since the top and bottom of the objects occupy the same X & Y coordinate on the ground. This artifact of relief displacement can cause some image distortions or illusions, particularly along the joint between orthophoto sheets. While sometimes disturbing, most are not defects in the image product.

Digital Orthophoto Generation

Creation of digital orthophotography starts with careful planning and ultimately concludes with the final image product. The scale of the output product will determine the scale at which the original aerial photography will be acquired. If a final product scale is defined as 1:5,000, the original photography is acquired at a nominal scale of 1:30,000. In preparation for an aerial flight, ground control points must be identified or established and monument so that they can be seen and recorded on the film. The X, Y & Z values for these points are known through ground surveying techniques. These points form the basis for control and coordinate assignment through a process of aerotriangulation. Several commercial firms are now enhancing the ground control through the use of airborne GPS and supporting ground station data collection. This new addition to the control process shows great promise. This control process provides the groundwork for completion of one of the 4 steps/corrections defined earlier.

Once the photography has been acquired and the necessary triangulation calculations have been completed, the photography is ready for the DEM collection. The DEM will form the basis for the correction of scale differences across the aerial imagery due to elevation changes. It will also be used to remove the relief displacement in the terrain. The elevation data is collected using an analytical stereo plotter to view the photography in 3-D and collect a representative sample of elevation points that will describe the relief of the area. The amount and type of information collected in the DEM will vary.

With the DEM collection complete, the photography is ready to be scanned and converted into a digital image. In the ideal situation, one aerial photograph will be used to create an entire orthophoto. The area should come from the central portion of the original photography to minimize any lens distortion near the edges of the photo. Photographs are scanned at a very high resolution to assure a high image quality in the final product. It is during the scanning process that defects of dirt and lint pieces can be added to the digital orthophoto image detracting from the quality of the final product. In addition, any scratches in the original photography that would normally be minimized during optical enlargements will be clearly be captured and preserved in the scanning process making them clearly visible in the final product.

The actual orthophoto creation is a computer-based process that marries the rasterized aerial photograph with the DEM. This process allows for the software to reposition the pixels of the scanned aerial photo to remove the effects of relief displacement and terrain elevation differences. With pixels properly positioned and associated X & Y coordinate values assigned the orthophoto is ready for viewing. The resulting image is now at constant scale across the entire image. Correction for tonal differences between images is the only remaining process to complete.

Tonal Correction

Radiometric corrections may be necessary to smooth tone or color differences between orthoimages to improve the overall image quality. Pixel brightness values range between 0 and 255, and in some cases localized adjustments may be required. If the photography is flown just prior to leaves returning to the trees, matching images between flight lines recorded on different dates may be challenging. Differences in the time of day that the photography is acquired can also hinder the radiometric balancing between digital images. These corrections are most often made using image enhancement software and are often based on the preferences of the user.

Bibliography and Additional Information

Parts of this section were extracted from Digital Orthophotography and GIS (http://www.uvm.edu/~jschlage/p124/p124.html) by Gary S. Smith, President; Green Mountain GeoGraphics, Ltd.

Additional information can be found on the USGS web site at http://mcmcweb.er.usgs.gov/index.html.

Searching for *"orthophoto creation"* in AltaVista or Yahoo also gives a good list of additional sites that explain how orthophotos are developed.