Software for automated image-to-image co-registration

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This presentation represents an *interim status report*. Our SBIR Phase II project is in its second year, and is scheduled for completion at the end of 2006.

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Phase I: 2003

Phase II: 2004 – 2006

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NASA Stennis Space Center

COTR: Bill Graham

Basic Premise

In spite of excellent quality in state of the art orthorectification software, camera models, and digital elevation models, two orthorectified images of the same area often exhibit minor errors relative to each other.

Although the absolute geometric accuracy is typically excellent, the relative accuracy of the image-to-image co-registration can be improved. For automated change detection at the scale of one pixel, the relative accuracy of two independently created orthophotos is often inadequate.

The fundamental goal of this SBIR Project is to develop software that applies multiple techniques to achieve subpixel precision in the co-registration of image pairs.

Project Objectives

- Develop software to fine-tune image-to-image co-registration, presuming images are orthorectified prior to input.
- Create a reusable software development kit (SDK) to enable incorporation of these tools into other software.
- Provide automated testing for quantitative analysis.

Project Deliverables

- Software development kit (SDK), developed in C++ (ANSI standard)

- Windows application
  - For automated testing (.NET framework)
  - Example application for SDK implementation

Features & Benefits
of image co-registration tools

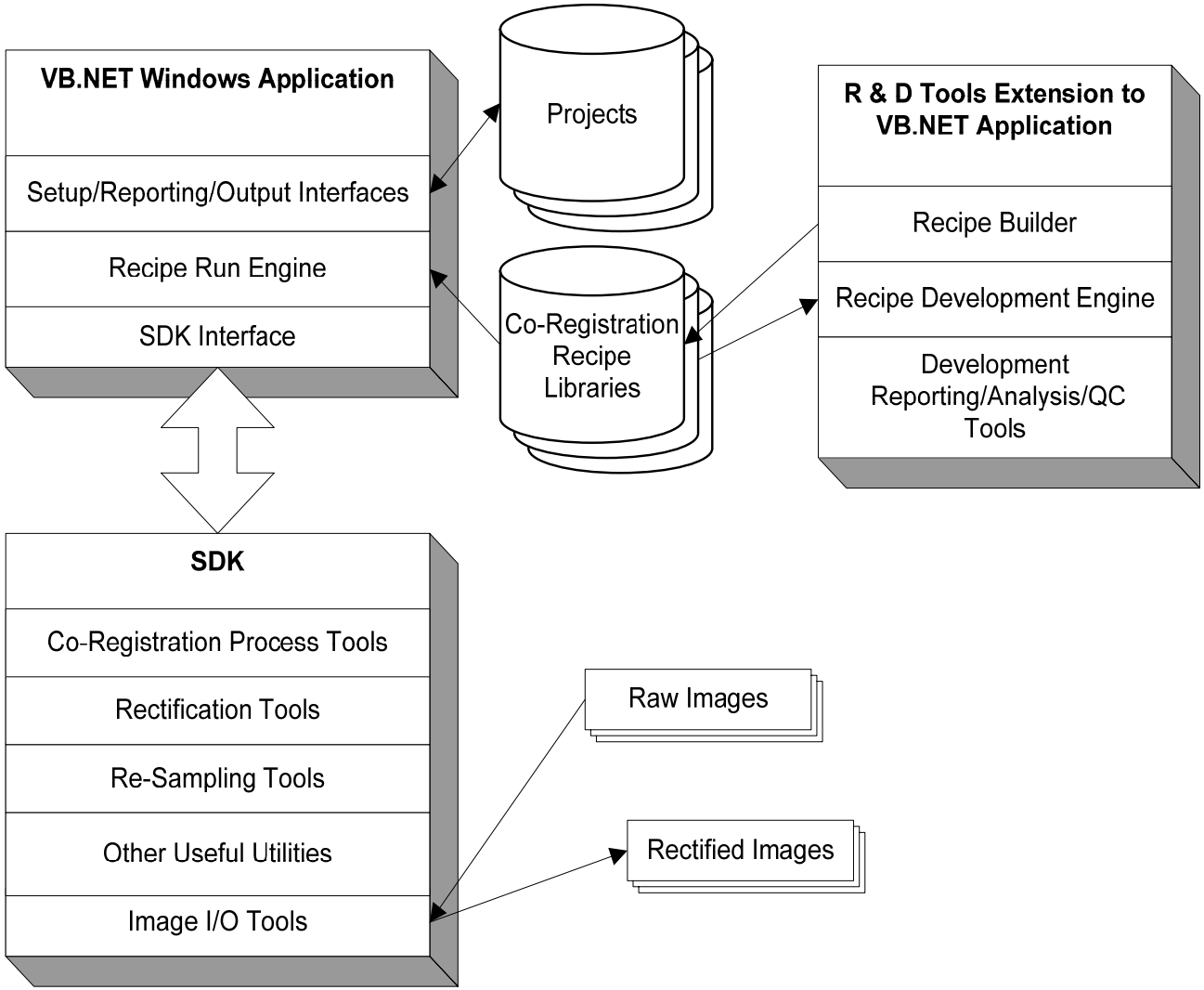
FEATURES

- Will provide for very accurate (sub-pixel) image-to-image co-registration, assuming input image data is *already* well registered.
- SDK will allow incorporation of these tools into other software.
- Test system (Windows .NET compliant) will provide ability to compare effectiveness of alternative methods.

BENEFITS

- Improves the accuracy of automated change detection.
- Enables a User with a need for these tools to customize them for their application.
- Enables user to add new technology and determine if it improves the results in *their* application.

Software Architecture



Primary Functions – SDK & Windows Application

- Change Detection
- Identification of tie points
  - (a.k.a. matching points, landmarks, pass points)
- Automatic measurement of initial and final accuracy
- QC tools

Basic Software Flowchart

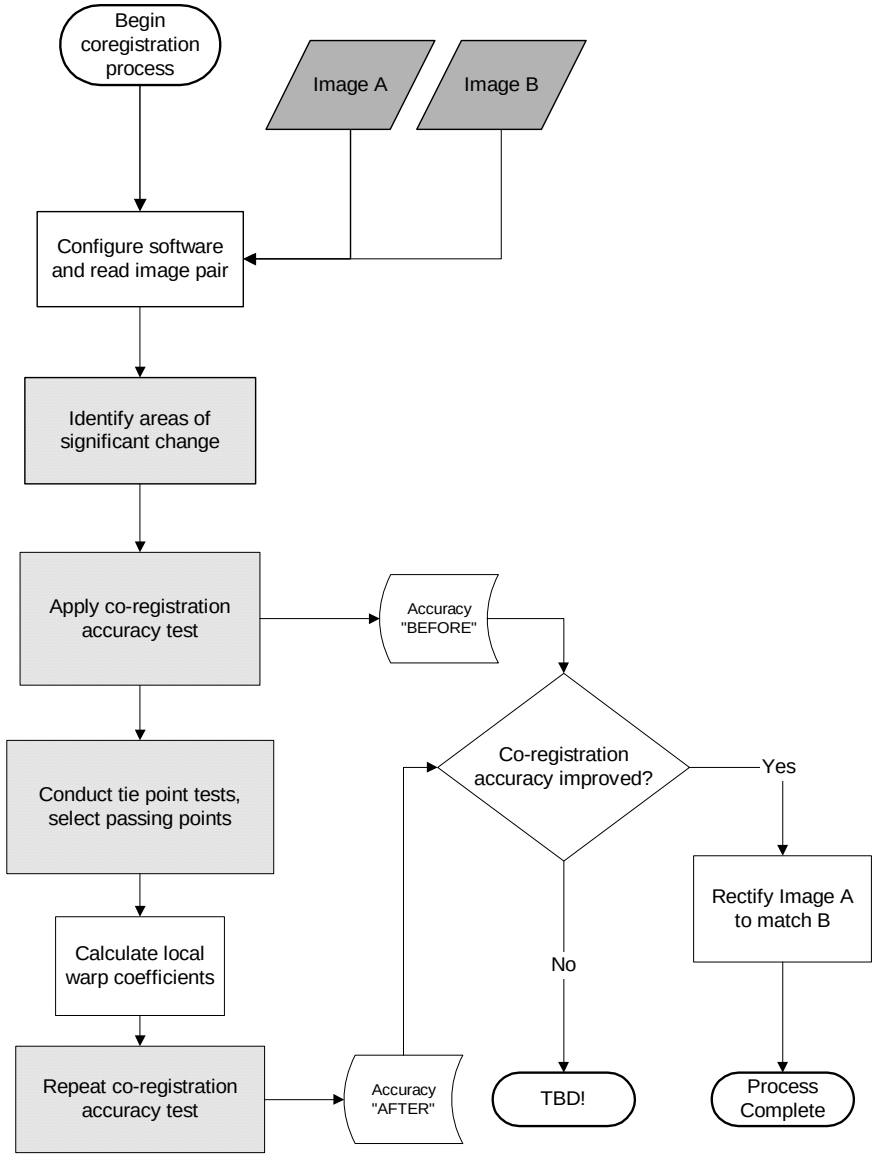
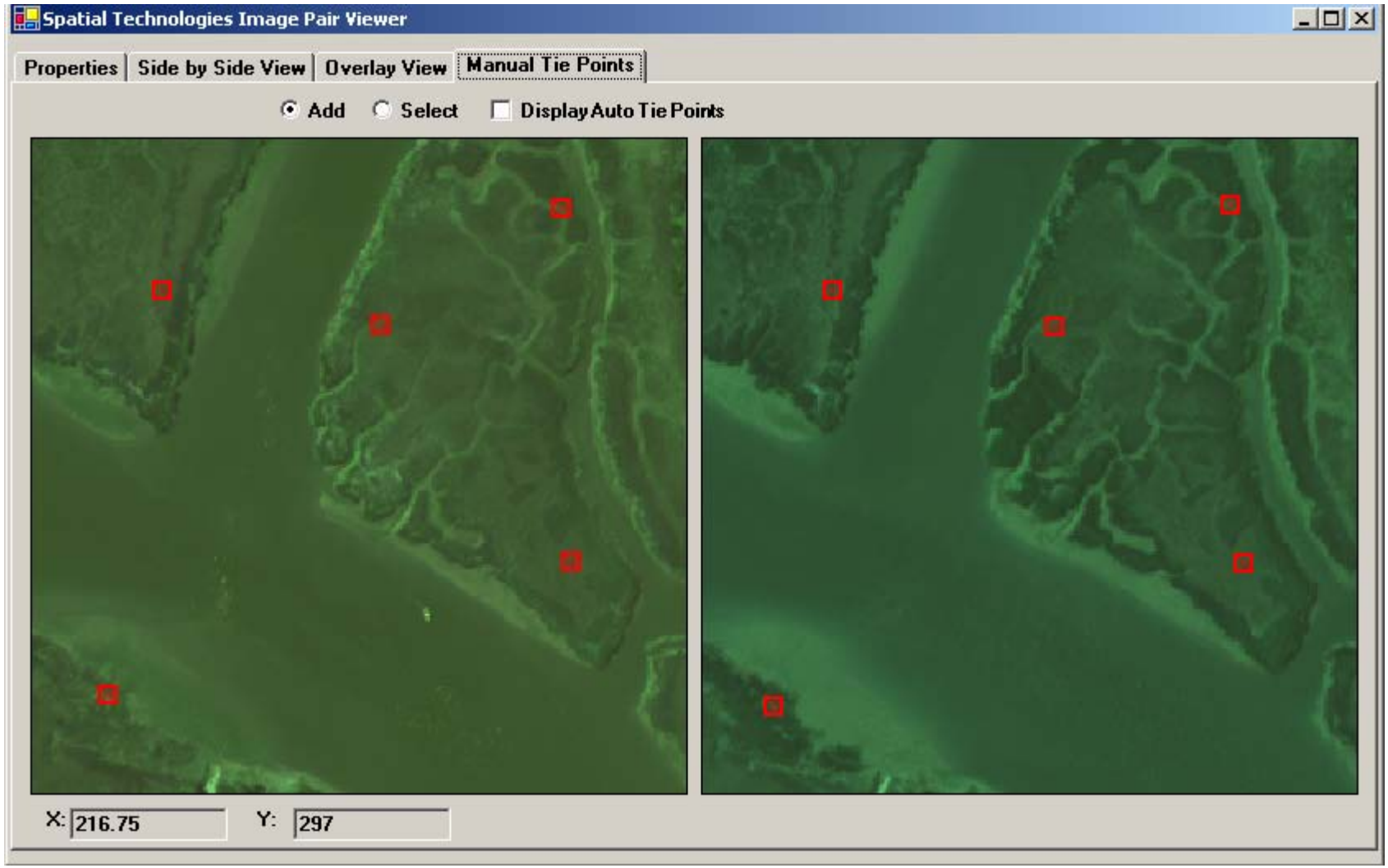
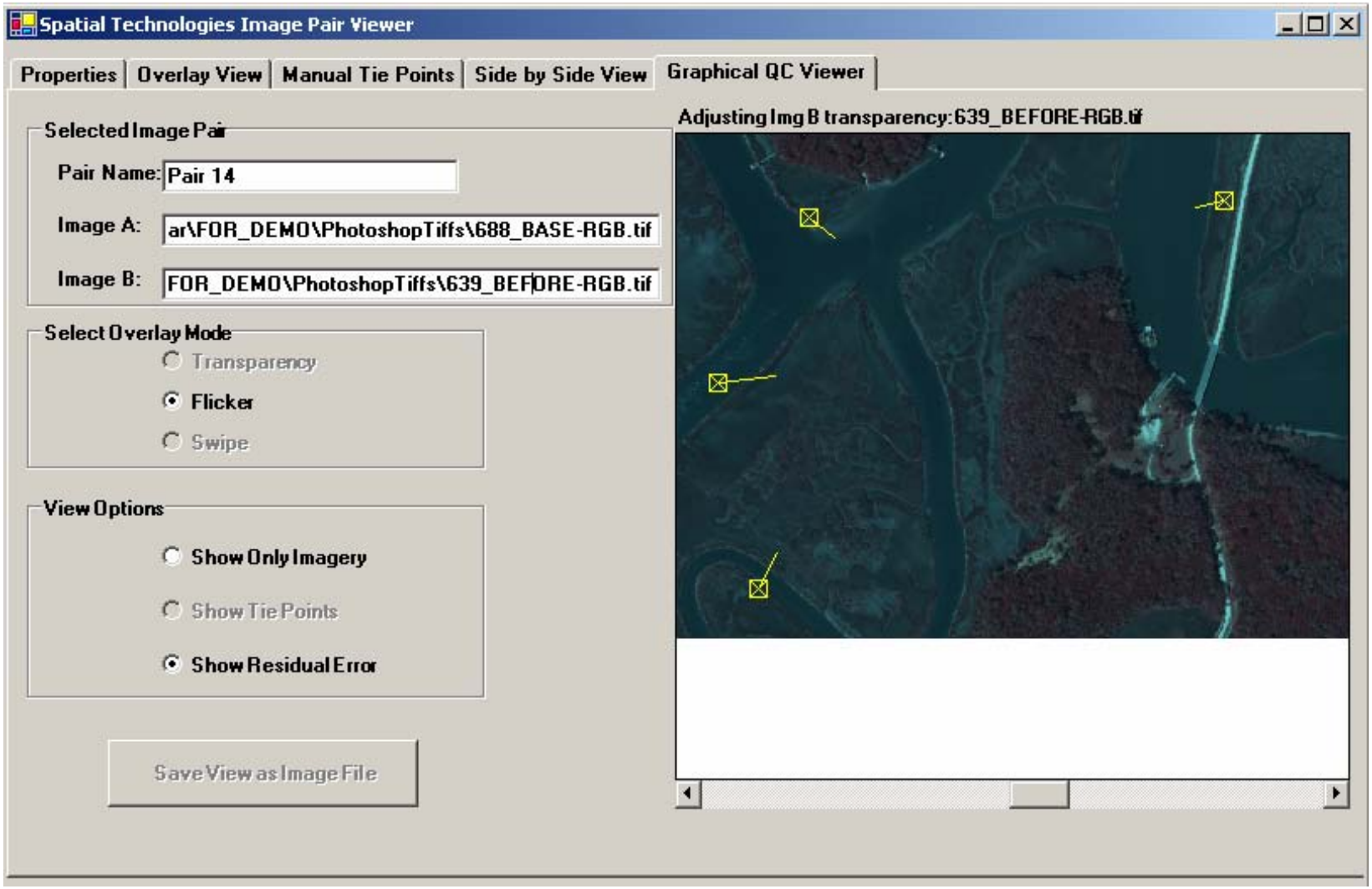


Image Pair QC tools



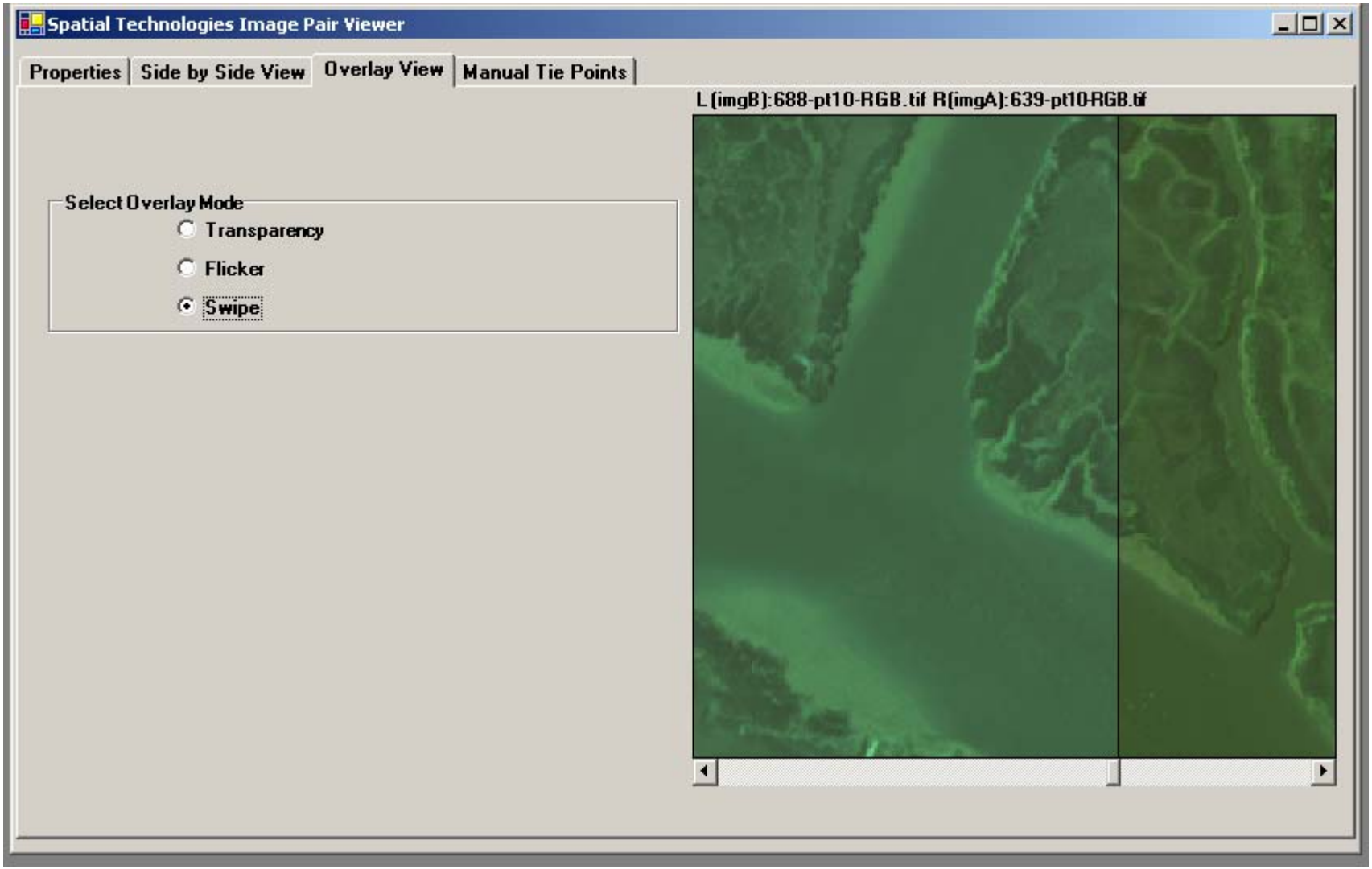
Side by side tie point view

Image Pair QC tools



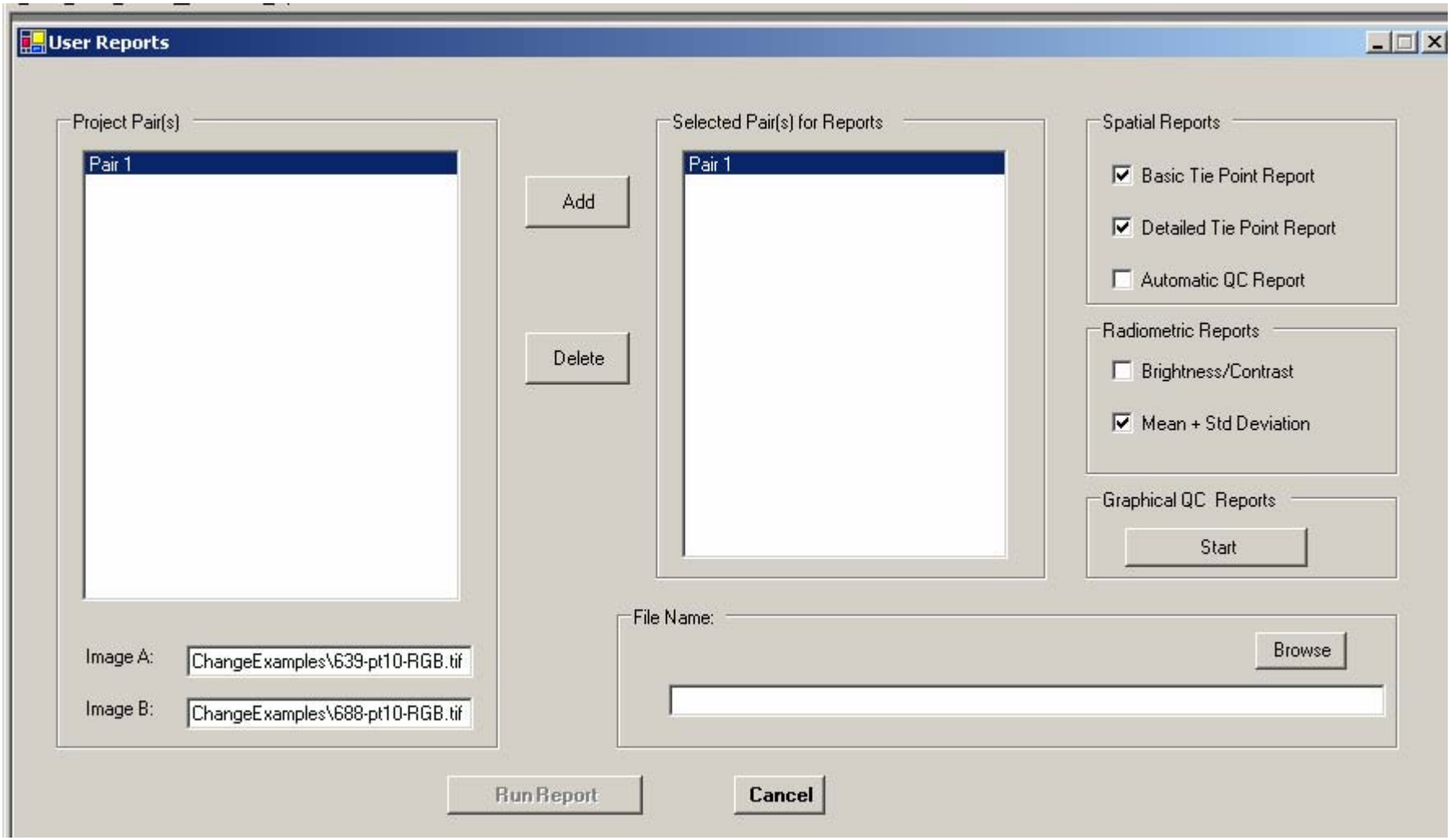
Residual tie point error view

Image Pair QC tools



Overlay view

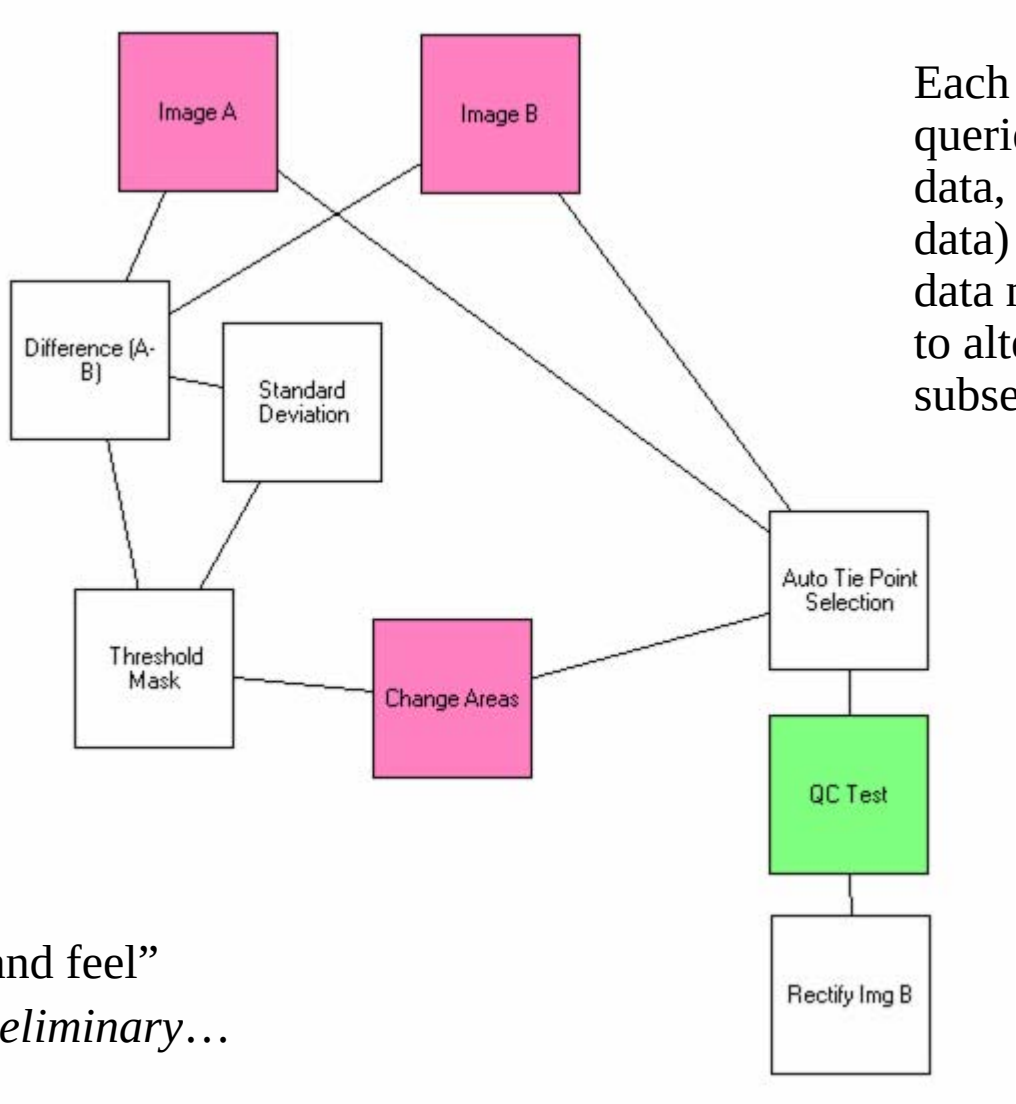
Reporting Functions



Added Functions – Development & Validation Tools

- Recipe Builder
  - For algorithm development
  - Intuitive GUI for linking core processes together into complex algorithms
  - User can query & modify process data
- Recipe Validation
  - Batch processing of recipes against multiple input datasets, for statistical analysis

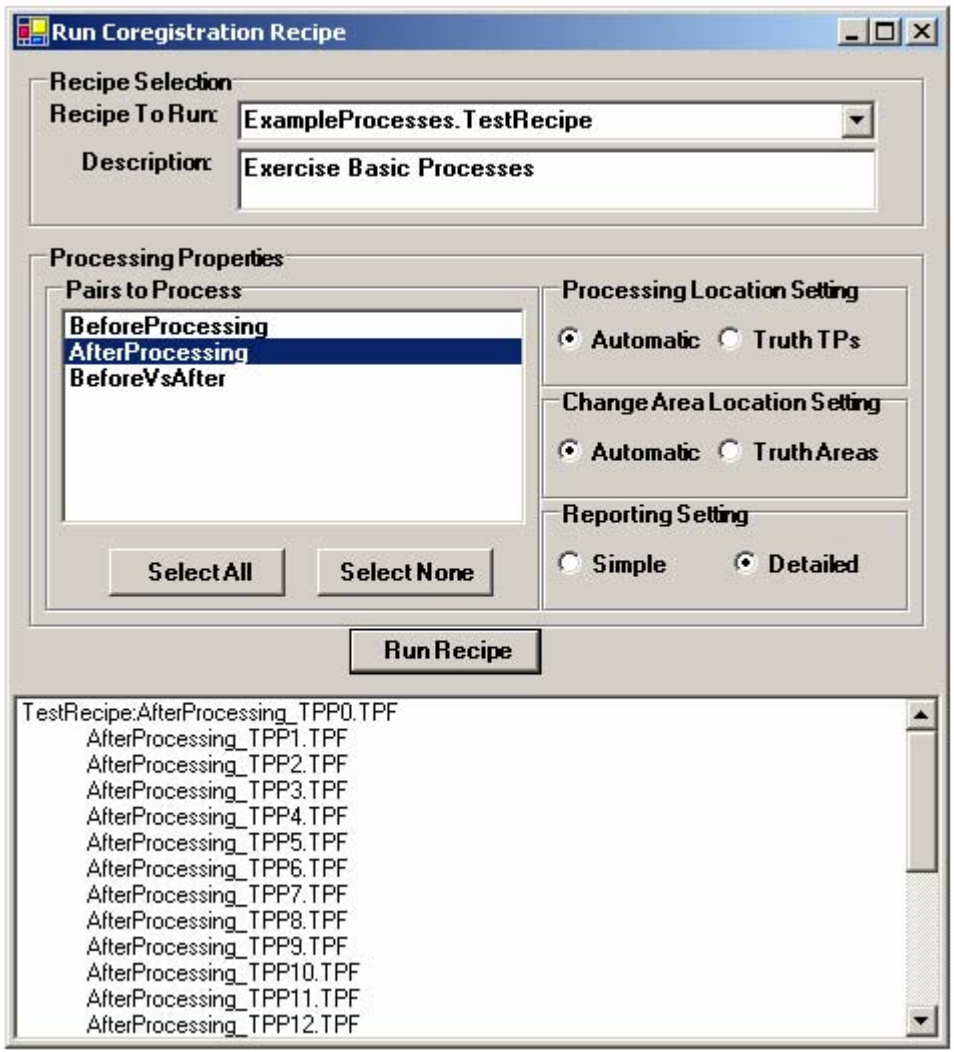
“Recipe Builder”



Each process can be queried (input & output data, configuration data) for testing, and data may be modified to alter the results of subsequent processes.

Note the “look and feel” of this UI are *preliminary*…

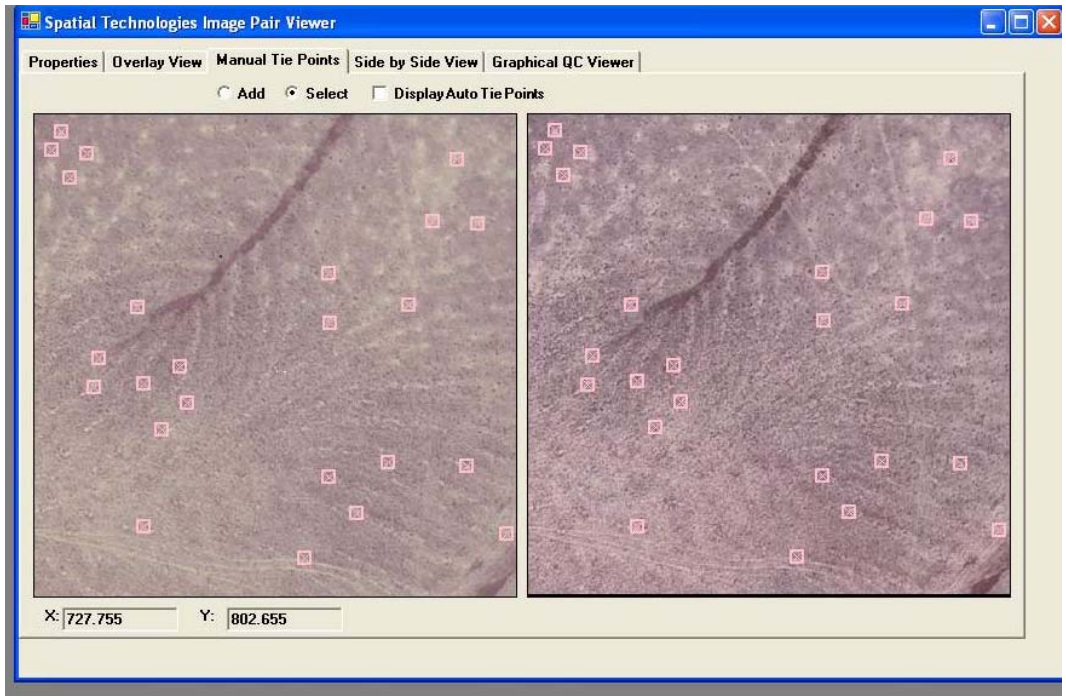
Recipe Validation



"Recipes" (integrated algorithms) may be executed with multiple input pairs to compare results and validate the recipe.

Preliminary Results

- Example #1:
  - Subset of orthorectified air photo pair (Source: USDA APFO).
  - Relative Error (RMS): 2.95 meters
  - After processing? *TBD*



Target markets

for software and/or services

- Industries:
  - Defense
  - Agriculture
  - Environment
  - Urban planning/Local Government
  - Medical imaging?
  - Machine vision/automated inspection?

Project Collaborators

- Dr. Doug Stow (San Diego State University)
- Dr. Ardeshir Goshtasby (Wright State University)
- Dr. John Dwyer (USGS LP-DAAC)

- *Seeking more… (See next slide)*

Goals for JACIE workshop

March 14-16, 2006

- Identify agencies interested in using image co-registration tools:
  - Validate software requirements.
  - Provide image data for testing.
  - Assist with BETA testing.
  - Utilize software when complete.

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