ReadMe file for itkWAMoptimizer

Brief Description:
This application is a supplement to the paper submitted by D. Wang, R. Tamburo, G. Stetten entitled "Cumulative Gaussian Curve Fitter for Boundary Parameterization" to the 2005 ITK Workshop at MICCAI.

Programming Environment:
This application was written with the toolkits: VTK 4.2, FLTK 1.1.6, and ITK 2.0.1. The GUI was developed with FLUID. It has been successfully tested with Visual Studio 6.0 (Windows XP) and GCC 3.3.3 (SuSE Linux).

Changes to Base Classes:
Functionality added to itkCumulativeGaussianCostFunction:
- *GetDerivative*: Defined the partial derivatives for the cumulative Gaussian.
- *CalculateGTFitError*: Calculate a Fit Error between the estimate and ground-truth.
- *SetGroundTruthDataArray*: Set the ground-truth data as determined from user-entered parameters.
- *GenerateRandomNumberArray*: Generate seeded random numbers in a user-determined interval. Used for adding random noise to input data.
- *SetAddNoiseFlag*: Flag for adding noise to input data.

Functionality added to itkCumulativeGaussianOptimizer:
- *NumberOfIterations*: Number of iterations required for optimization convergence.
- *TrackOptimization*: Flag for tracking the results of the optimization.
- *CalculateFitErrorWhileOptimizing*: Calculates the fit error following each iteration.
- *GetFitErrorList*: Returns the list of fit errors accumulated during optimization.

Installation:
A CMakeLists file has been included with the source code. "Makefiles" were successfully generated with CMake versions 2.0.5 and 2.0.6 on SuSE Linux and Windows XP, respectively. Functionality for MAC computers has been included in the CMakeLists file, but has not been tested.

Use:
The GUI has 4 main panels as shown in the figure below. In the upper left panel, labeled "Generate a Cumulative Gaussian," are fields for the user to enter parameter values for the Cumulative Gaussian. Also in the upper left panel are options to choose the number of samples generated, add noise to the generated samples, and select verbose mode. Once the "Optimize!" button is pressed, samples are generated from the parameters and optimization proceeds.

Once the optimization is complete: 1. The lower left panel, labeled "Output Information," is updated with the parameter estimates, absolute difference error in parameter estimates, fit error, number of iterations required to optimize, and time to optimize. 2. The upper

right panel will be updated with a plot of the generated cumulative Gaussian (yellow) and the cumulative Gaussian calculated from the estimated parameters (red). 3. The lower right panel will be updated with a plot of the Fit Error calculated at each iteration of the optimization procedure.

Multiple curves can be optimized by setting *m_NumberOfTrials* at line 417 in *itkWAMoptimizerBase.cxx* to the desired number of curves desired. Parameters can be incrementally adjusted for each trial by setting the desired intervals for each parameter at line 579 in the same file.

To generate the data for producing Figure 2 in the paper, set *NumberOfTrials* to 10 and leave the parameters set to default. After optimizing, an ASCII file named *errorList.txt* should be in the build directory. This file contains the fit errors for each iteration of the optimization. Plotting these numbers versus iteration count should result in Figure 4.
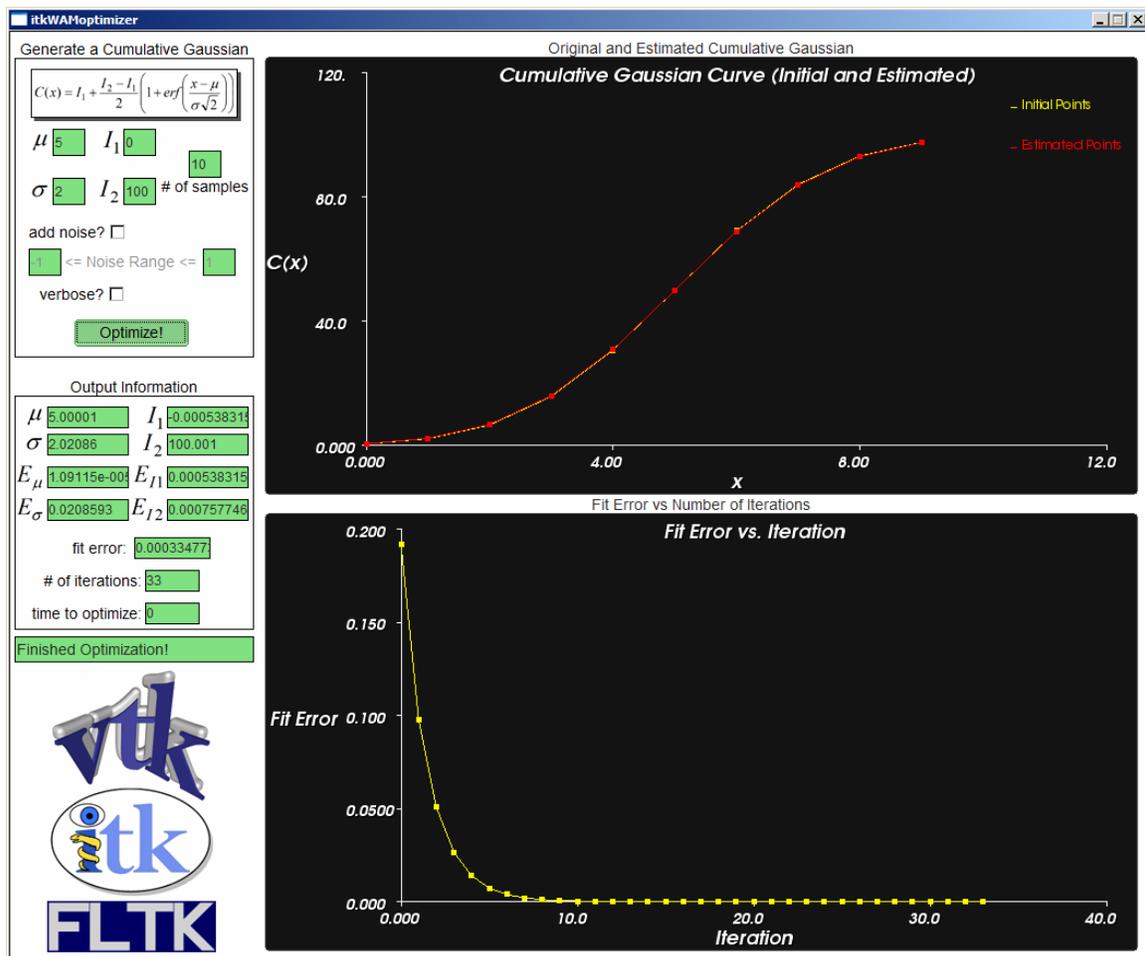
Screen capture of itkWAMoptimizer after generating a noiseless set of data from user entered parameters. Top plot shows the generated data (yellow) and the estimated data after optimization (red). Bottom plot shows the Fit Error vs. Iteration.