The author(s) shown below used Federal funds provided by the U.S. Department of Justice and prepared the following final report:

Document Title:	**Minutia Deviation Tool: Software Test Report (STR), (Version 1.0)**
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Document No.:	**249558**
Date Received:	**December 2015**
Award Number:	**2010-IJ-CX-K024**

This report has not been published by the U.S. Department of Justice. To provide better customer service, NCJRS has made this federally funded grant report available electronically.

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Minutia Deviation Tool: Software Test Report (STR)

(Version 1.0)

March 27, 2015

DOJ Office of Justice Programs
National Institute of Justice
Sensor, Surveillance, and Biometric Technologies (SSBT) Center of Excellence (CoE)

Prepared for

Defense Biometrics & Forensics
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UNCLASSIFIED

This project was supported by Award No. 2010-IJ-CX-K024 and 2014-ZD-CX-K001, awarded by the National Institute of Justice, Office of Justice Programs, U.S. Department of Justice. The opinions, findings, and conclusions or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect those of the Department of Justice.

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CHANGE HISTORY

Version/ Revision	Revision Date	Description of Change
1.0	03/27/15	Testing of MDT Beta Build v1

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1.0 SCOPE

1.1 Identification

Minutia Deviation Tool (MDT), version 1.0 (beta), dated 20150327.

1.2 System Overview

The MDT is a prototype Computer Software Configuration Item (CSCI) (i.e., software utility) that shall aid a user in designating equivalent minutia pairs across two fingerprint biometric images and calculating the pair's minutia spatial deviations. MDT shall serve as a tool to support research and analysis of contactless and contact-based fingerprint data.

No prior software development exists for the MDT.

The tool shall be used by biometrics researchers in academia, government, and industry, as designated and distributed by the sponsors, in an independent manner without operations or maintenance support from the developer. The MDT version being developed shall be in a Beta state, not suitable for general release, but possessing suitable stability for use by knowledgeable and experienced researchers.

MDT development is part of the Contactless Fingerprint Research (Phase 2) project. The effort is sponsored by the Director, Defense Biometrics and Forensics in partnership with the National Institute of Justice (NIJ).

The MDT is being developed by ManTech Advanced Systems International, Inc. (and its subcontractor, Azimuth, Inc.) under the National Institute of Justice (NIJ) Sensor, Surveillance, and Biometric Technologies (SSBT) Center of Excellence (CoE) cooperative agreements (Award# 2010-IJ-CX-K024 and 2014-ZD-CX-K001). The NIJ SSBT CoE is a center within the National Law Enforcement and Corrections Technology Center (NLECTC) System. The Center provides scientific and technical support to NIJ's R&D efforts. The Center also provides technology assistance, information, and support to criminal justice agencies. The Center supports the sensor and surveillance portfolio and biometrics portfolio. The CoEs are the authoritative resource within the NLECTC System for both practitioners and developers in their technology area(s) of focus. The primary role of the CoEs is to assist in the transition of law enforcement technology from the laboratory into practice by first adopters.

1.3 Document Overview

The Software Test Report (STR) document is a record of the qualification testing performed on the Computer Software Configuration Item (CSCI) capabilities specified in the Software Requirements Specification (SRS) and Software Design Description (SDD) documents.

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2.0 REFERENCED DOCUMENTS

- Department of Defense (DOD), *DI-IPSC-81439A Software Test Description Data Item Description (STD DID)* (December 15, 1999).

- National Institute of Standards and Technology (NIST), *ANSI/NIST-ITL 1-2011 Data Format for the Interchange of Fingerprint, Facial & Other Biometric Information* (January 2012).

- Federal Bureau of Investigation (FBI), *IAFIS-DOC-01078-9.3 Electronic Biometric Transmission Specification (EBTS) Version 9.3* (December 9, 2011).

- ManTech Advanced Systems International (MASI), *Contactless Fingerprint Research (Phase 2) Program Narrative – Draft V7* (January 15, 2014).

- MASI and Azimuth, Inc.; *Evaluation of Contact versus Contactless Fingerprint Data (Final Report v2)* (January 23, 2014).

- MASI, *Minutia Deviation Tool: Software Requirements Specification FINAL REVISED* (June 12, 2014).

- Neurotechnology, *MegaMatcher 4.5, VeriFinger 6.7, VeriLook 5.4, VeriEye 2.7, and VeriSpeak 2.0 SDK Developer's Guide* (2014).

- MASI, *Minutia Deviation Tool: Software Design Description, Version 2.0* (March 17, 2015).

- MASI, *Minutia Deviation Tool: Software Test Description* (March 17, 2015).

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3.0 OVERVIEW OF TEST RESULTS

3.1 Overall Assessment

The MDT passed all tests and performed without error or bugs. All designed capabilities were available and functioned in accordance with the SRS and SDD.

3.2 Impact of Test Environment

There is no expected impact of the test environment on the operational performance of the MDT. The software tool is designed for use in research environments on standard office computers. The test environment is an average computer of that type.

3.3 Recommended Improvements

None

3.4 Test Data

All tests were performed with provided sample test data. The data is located in "\MDTTool\TestData". The test data consists of image files, corresponding comma-separated value (CSV) minutiae text files, and prepared Latent Friction Ridge Feature Search (LFFS) EBTS files of those same image/CSV pairs.

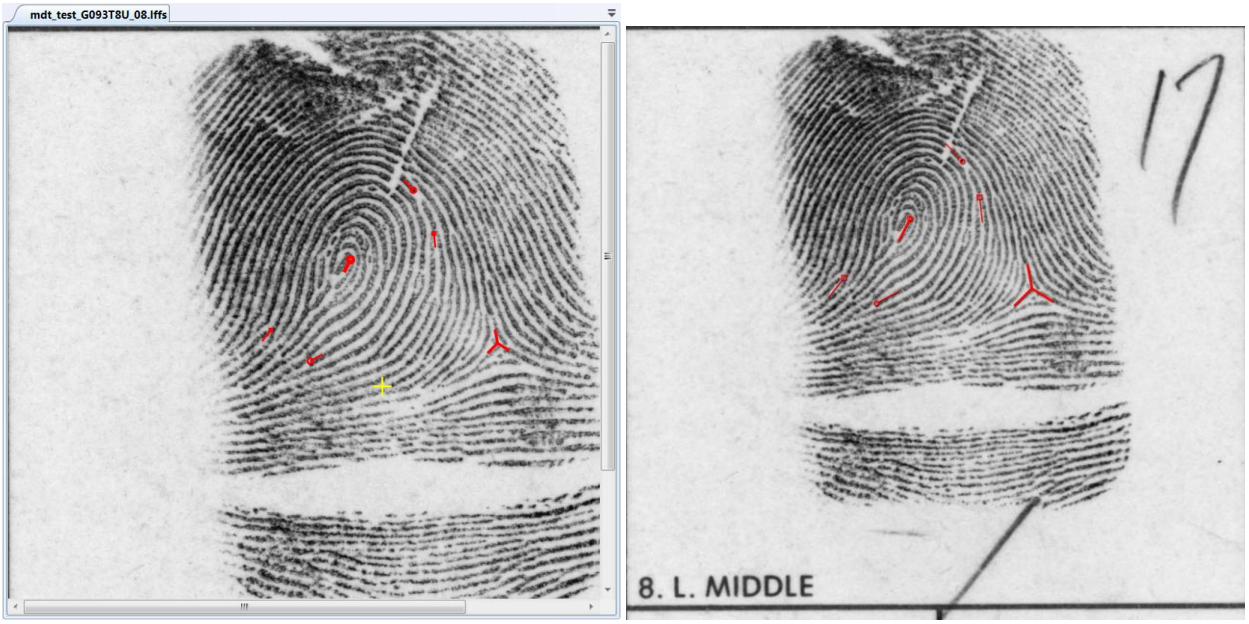

Figure 1: mdt_test_G093T8U_08 Expected Display
(Left) MDT expected display of mdt_test_G093T8U_08 lffs or image/CSV; (Right) Display of mdt_test_G093T8U_08.lffs from ULW Latent Editor.

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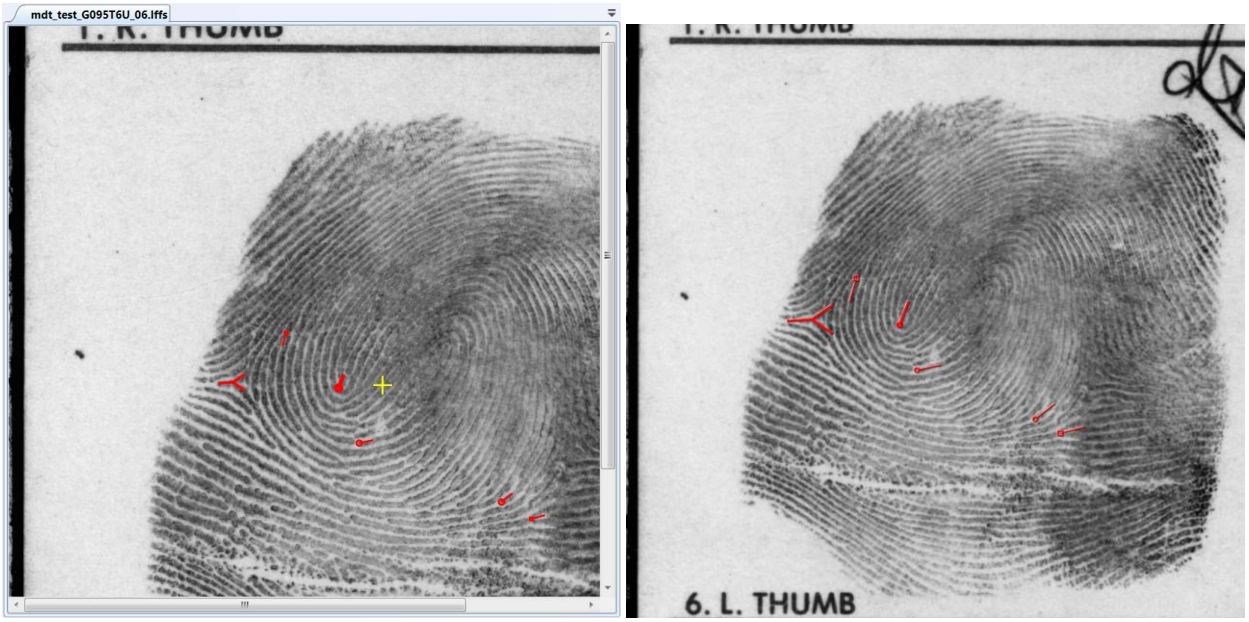

Figure 2: mdt_test_G095T6U_06 Expected Display
(Left) MDT expected display of mdt_test_G095T6U_06 lffs or image/CSV; (Right) Display of mdt_test_G095T6U_06.lffs from ULW Latent Editor.

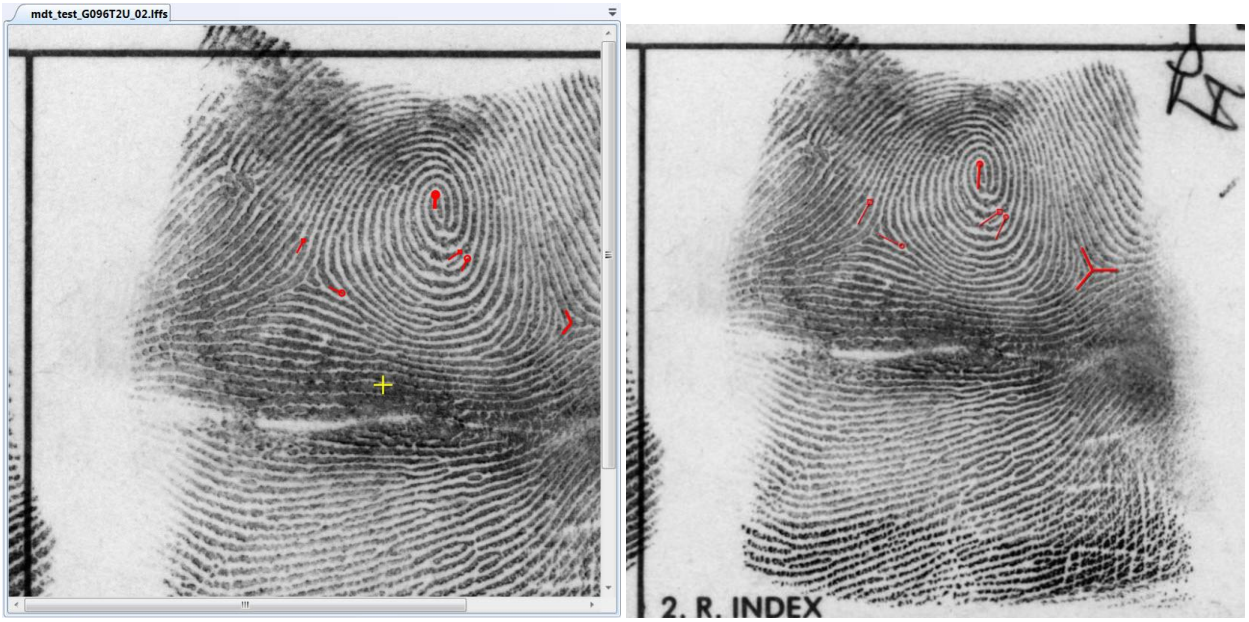

Figure 3: mdt_test_G096T2U_02 Expected Display
(Left) MDT expected display of mdt_test_G096T2U_02 lffs or image/CSV; (Right) Display of mdt_test_G096T2U_02.lffs from ULW Latent Editor.

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Table 1: Test Data Minutia Details

mdt_test_G093T8U_08.lffs	mdt_test_G095T6U_06.lffs	mdt_test_G096T2U_02.lffs
(1859,1265)@243° type=Core RPU=0	(1793,1966)@69° type=Core RPU=0	(2316,919)@266° type=Core RPU=0
(1641,1814)@28° type=RidgeEnding RPU=0	(2677,2586)@38° type=RidgeEnding RPU=0	(1808,1453)@155° type=RidgeEnding RPU=0
(2200,889)@133° type=RidgeEnding RPU=0	(1905,2266)@12° type=RidgeEnding RPU=0	(2489,1265)@246° type=RidgeEnding RPU=0
(2311,1123)@276° type=Bifurcation RPU=0	(2840,2677)@15° type=Bifurcation RPU=0	(2449,1229)@214° type=Bifurcation RPU=0
(1427,1646)@232° type=Bifurcation RPU=0	(1509,1666)@254° type=Bifurcation RPU=0	(1600,1168)@242° type=Bifurcation RPU=0

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4.0 DETAILED TEST RESULTS

4.1 Display Fingerprint Images and Minutiae

Capability: The MDT allows a user to open a pair of Latent Friction Ridge Features Search (LFFS) Electronic Biometrics Transmission Specification (EBTS) files or two sets of Images and Text files to display fingerprint images and associated minutiae data contained within the files. The minutiae are overlaid on the associated fingerprint image. The user can select individual minutiae to display details about the minutia location, position, and classification.

4.1.1 Test Case 1: New Session with Image/CSV

MDT System Version 0.1.0 Test Case	
Test Case ID: T-01	**Test Item:** New Session with Image/CSV
Requirements Addressed: 11, 13	
Test Case Description: Verify that a new session can be initiated with fingerprint image and minutiae CSV text inputs as the baseline and comparison	
Prerequisites	
Test Environment: Default	
Required Interfaces: MDT System	
Assumptions: N/A	
Test Inputs: Files located in the "\MDTTool\TestData" folder 1. Mdt_test_G093T8U_08.bmp, mdt_test_G093T8U_08.csv 2. Mdt_test_G095T6U_06.bmp, mdt_test_G095T6U_06.csv 3. Mdt_test_G096T2U_02.bmp, mdt_test_G096T2U_02.csv	

Step #	User Action	Expected Result	Pass = P Fail = X
1.	Open the MDT.	MDT opens.	P
2.	Click *File* → *New* → *New MDT Session.*	A pop-up window will appear titled "NewSessionWizard".	P
3.	Click *Next.*	The window will advance, requesting that the user select the Baseline fingerprint.	P
4.	Click the *Image & CSV File* radio button.	The file input field will be replaced with two input fields, one for the Fingerprint Image file and a second field for the Fingerprint Minutia file.	P
5.	a. Click *Browse* for the Baseline Fingerprint Image file and locate the "\MDTTool\TestData" folder.	The browse window closes and the file path populates the "NewSessionWizard" window.	P

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	b. Select the Baseline Fingerprint Image file, "Mdt_test_G093T8U_08.bmp" and click *Open*.		
6.	a. Click *Browse* for the Baseline Fingerprint Minutia file and locate the "\MDTTool\TestData" folder. b. Select the Baseline Fingerprint Minutia file, "Mdt_test_G093T8U_08.csv" and click *Open*.	The browse window closes and the file path populates the "NewSessionWizard" window.	P
7.	Click *Next.*	The window will advance, requesting that the user select the Comparison fingerprint.	P
8.	Click the *Image & CSV File* radio button.	The file input field will be replaced with two input fields, one for the Fingerprint Image file and a second field for the Fingerprint Minutia file.	P
9.	a. Click *Browse* for the Comparison Fingerprint Image file and locate the "\MDTTool\TestData" folder. b. Select the Comparison Fingerprint Image file, "Mdt_test_G095T6U_06.bmp" and click *Open*.	The browse window closes and the file path populates the "NewSessionWizard" window.	P
10.	a. Click *Browse* for the Comparison Fingerprint Minutia file and locate the "\MDTTool\TestData" folder. b. Select the Comparison Fingerprint Minutia file, "Mdt_test_G095T6U_06.csv" and click *Open*.	The browse window closes and the file path populates the "NewSessionWizard" window.	P
11.	Click *Next.*	The window will advance, requesting that the user review the session inputs.	P
12.	Click *Finish.*	The pop-up window will close and the MDT Graphical User Interface (GUI) will update to show the two images and their minutiae sets in the pair of viewing windows. The Baseline display will appear the same as Figure 1. The Comparison display will appear the same as Figure 2.	P
13.	a. Click *File* → *Close Window.* b. When asked whether to "Save	The image display clears and resets to the initial MDT state.	P

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	before closing session?" Click *No*.		
14.	Repeat steps 2 – 13 using "Mdt_test_G096T2U_02.bmp" and "Mdt_test_G096T2U_02.csv" as the Baseline files and "Mdt_test_G093T8U_08.bmp" and "Mdt_test_G093T8U_08.csv" as the Comparison files.	The pop-up window will close and the MDT GUI will update to show the two images and their minutiae sets in the pair of viewing windows. The Baseline display will appear the same as Figure 3. The Comparison display will appear the same as Figure 1.	P
15.	Repeat steps 2 – 13 using "Mdt_test_G095T6U_06.bmp" and "Mdt_test_G095T6U_06.csv" as the Baseline files and "Mdt_test_G096T2U_02.bmp" and "Mdt_test_G096T2U_02.csv" as the Comparison files.	The pop-up window will close and the MDT GUI will update to show the two images and their minutiae sets in the pair of viewing windows. The Baseline display will appear the same as Figure 2. The Comparison display will appear the same as Figure 3.	P

Results		
PASSED: ☒ FAILED: ☐		
Actual Results if Fail: N/A		
Tester's Name: Lars Ericson	**Date/Time:** 2015-03-27 1034	**Actual time to complete:** 12 minutes
Comments: None		

4.1.2 Test Case 2: New Session with LFFS

MDT System Version 0.1.0 Test Case	
Test Case ID: T-02	**Test Item:** New Session with LFFS
Requirements Addressed: 01, 11	
Test Case Description: Verify that a new session can be initiated with fingerprint EBTS LFFS file inputs as the baseline and comparison	
Prerequisites	
Test Environment: Default	
Required Interfaces: MDT System	

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Assumptions: N/A

Test Inputs: Files located in the "\MDTTool\TestData" folder

1. Mdt_test_G093T8U_08.lffs
2. Mdt_test_G095T6U_06.lffs
3. Mdt_test_G096T2U_02.lffs

Step #	User Action	Expected Result	Pass = P Fail = X
1.	Open the MDT.	MDT opens.	P
2.	Click *File* → *New* → *New MDT Session.*	A pop-up window will appear titled "NewSessionWizard".	P
3.	Click *Next.*	The window will advance, requesting that the user select the Baseline fingerprint. The *LFFS File* radio button will be pre-selected.	P
4.	a. Click *Browse* and locate the "\MDTTool\TestData" folder. b. Select the Baseline file, "Mdt_test_G093T8U_08.lffs" and click *Open.*	The browse window closes and the file path populates the "NewSessionWizard" window.	P
5.	Click *Next.*	The window will advance, requesting that the user select the Comparison fingerprint. The *LFFS File* radio button will be pre-selected.	P
6.	a. Click *Browse* and locate the "\MDTTool\TestData" folder. b. Select the Comparison file, "Mdt_test_G095T6U_06.lffs" and click *Open.*	The browse window closes and the file path populates the "NewSessionWizard" window.	P
7.	Click *Next.*	The window will advance, requesting that the user review the session inputs.	P
8.	Click *Finish.*	The pop-up window will close and the MDT GUI will update to show the two images and their minutiae sets in the pair of viewing windows. The Baseline display will appear the same as Figure 1. The Comparison display will appear the same as Figure 2.	P
9.	a. Click *File* → *Close Window.* b. When asked whether to "Save before closing session?" Click *No.*	The image display clears and resets to the initial MDT state.	P
10.	Repeat steps 2 – 9 using "Mdt_test_G096T2U_02.lffs" as	The pop-up window will close and the MDT GUI will update to show the two	P

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	the Baseline file and "Mdt_test_G093T8U_08.lffs" as the Comparison file.	images and their minutiae sets in the pair of viewing windows. The Baseline display will appear the same as Figure 3. The Comparison display will appear the same as Figure 1.	
11.	Repeat steps 2 – 9 using "Mdt_test_G095T6U_06.lffs" as the Baseline file and "Mdt_test_G096T2U_02.lffs" as the Comparison file.	The pop-up window will close and the MDT GUI will update to show the two images and their minutiae sets in the pair of viewing windows. The Baseline display will appear the same as Figure 2. The Comparison display will appear the same as Figure 3.	P

Results		
PASSED: ☒ FAILED: ☐		
Actual Results if Fail: N/A		
Tester's Name: Lars Ericson	**Date/Time:** 2015-03-27 1039	**Actual time to complete:** 4 minutes
Comments: None		

4.1.3 Test Case 3: Save Session

MDT System Version 0.1.0 Test Case			
Test Case ID: T-03	**Test Item:** Save Session		
Requirements Addressed: 12, 15			
Test Case Description: Verify that a session can be saved to the local computer			
Prerequisites			
Test Environment: Default			
Required Interfaces: MDT System			
Assumptions: N/A			
Test Inputs: Files located in the "\MDTTool\TestData" folder 1. Mdt_test_G093T8U_08.lffs 2. Mdt_test_G095T6U_06.lffs			
Step #	**User Action**	**Expected Result**	**Pass = P Fail = X**

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1.	Carry out Test Case T-02 Steps 1 – 8.		
2.	Click *File* → *Save*.	A pop-up window will appear titled "Save As" showing a location on the local computer within Windows Explorer. The "File name" field will be populated with "MDTsession<*date_time*>.mdts", where <*date_time*> is the date and time of the action.	P
3.	a. Navigate to \MDTTool\TestData within Windows Explorer. b. Click *Save*.	The window closes and the MDT GUI updates to show the saved filename at the top of the main display window.	P
4.	Click *File* → *Save As.*	A pop-up window will appear titled "Save As" showing a location on the local computer within Windows Explorer. The "File name" field will be populated with "MDTsession<*date_time*>.mdts", where <*date_time*> is the date and time of the action.	P
5.	a. Navigate to \MDTTool\TestData within Windows Explorer. b. Delete the filename and enter "mdt_test03.mdts" as a new filename. c. Click *Save.*	The window closes and no changes to the MDT GUI occur.	P

Results		
PASSED: ☒ FAILED: ☐		
Actual Results if Fail: N/A		
Tester's Name: Lars Ericson	**Date/Time:** 2015-03-27 1041	**Actual time to complete:** 2 minutes
Comments: None		

4.1.4 Test Case 4: Open Session

MDT System Version 0.1.0 Test Case	
Test Case ID: T-04	**Test Item:** Open Session
Requirements Addressed: 11, 16	

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Test Case Description: Verify that a session can be opened from the local computer

Prerequisites

Test Environment: Default

Required Interfaces: MDT System

Assumptions: N/A

Test Inputs: Files located in the "\MDTTool\TestData" folder created from carrying out Test Case T-03

1. MDTsession<*date_time*>.mdts
2. Mdt_test03.mdts (optional)

Step #	User Action	Expected Result	Pass = P Fail = X
1.	Carry out Test Case T-03.		
2.	a. Click *File* → *Close Window*. b. When asked whether to "Save before closing session?" Click *No*.	The image display clears and resets to the initial MDT state.	P
3.	a. Click *File* → *Open* → *MDT Session*.	A pop-up window will appear titled "Open" showing a location on the local computer within Windows Explorer.	P
4.	a. Navigate to \MDTTool\TestData within Windows Explorer. b. Select "mdt_test03.mdts". c. Click *Open*.	The pop-up window will close and the MDT GUI will update to show the two images and their minutiae sets in the pair of viewing windows. The Baseline display will appear the same as Figure 1. The Comparison display will appear the same as Figure 2.	P

Results

PASSED: ☒ FAILED: ☐

Actual Results if Fail: N/A

Tester's Name:	**Date/Time:**	**Actual time to complete:**
Lars Ericson	2015-03-27 1044	3 minutes

Comments: None

4.1.5 Test Case 5: MDT GUI

MDT System Version 0.1.0 Test Case

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Test Case ID: T-05	**Test Item:** MDT GUI

Requirements Addressed: 10

Test Case Description: Verify that MDT provides a GUI with various subwindows – baseline image, comparison image, baseline data, comparison data, deviation calculations, and deviation/history log.

Prerequisites

Test Environment: Default

Required Interfaces: MDT System

Assumptions: N/A

Test Inputs: Files located in the "\MDTTool\TestData"
1. Mdt_test_G093T8U_08.lffs
2. Mdt_test_G095T6U_06.lffs
3. Mdt_test03.mdts (optional)

Step #	User Action	Expected Result	Pass = P Fail = X
1.	Carry out Test Case T-04 or *Open* mdt_test03.mdts.		
2.	Confirm main menu.	A menu bar is listed at the top of the window listing: "File", "Export", and "Adjust Center Markers."	P
3.	Confirm Baseline window.	The baseline image and minutiae are displayed in a larger window positioned in the center left. The baseline filename is listed in the upper tab of the window. Minutia markings are presented as small red shapes with directional line projecting out. The core mark in the center of the image is bold. The delta mark is an intersection of three lines.	P
4.	Confirm Baseline Data window.	A rectangular window is presented in the upper center that lists "Baseline Marker" and "Center". The Center fields are populated with X=2032 and Y=1950.	P
5.	Confirm Comparison window.	The comparison image and minutiae are displayed in a larger window positioned in the center left. The comparison filename is listed in the upper tab of the window. Minutia markings are presented as small red shapes with directional line	P

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		projecting out. The core mark in the center of the image is bold. The delta mark is an intersection of three lines.	
6.	Confirm Comparison Data window.	A rectangular window is presented in the upper center that lists "Comparison Marker" and "Center". The Center fields are populated with X=2032 and Y=1950.	P
7.	Confirm Deviation window.	A window is presented in the lower right that lists Relative and Absolute Deviations. A drop-down menu is available currently depicting "Cartesian Deviation Calculation." A *Mate Marker Pair* button is available.	P
8.	a. Click on the "History" tab on the bottom of the lower left subwindow. b. Confirm History Log.	a. The lower left subwindow changes from a blank "Mated" window to the "History" window listing the actions taken in the current session.	P

Results		
PASSED: ☒ FAILED: ☐		
Actual Results if Fail: N/A		
Tester's Name: Lars Ericson	**Date/Time:** 2015-03-27 1046	**Actual time to complete:** 2 minutes
Comments: None		

4.1.6 Test Case 6: Display Image/Minutiae

MDT System Version 0.1.0 Test Case	
Test Case ID: T-06	**Test Item:** Display Image/Minutiae
Requirements Addressed: 02, 03	
Test Case Description: Verify that a fingerprint image and associated minutiae set are displayed with the correct locations and types.	
Prerequisites	
Test Environment: Default	
Required Interfaces: MDT System	
Assumptions: N/A	

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Test Inputs: Files located in the "\MDTTool\TestData"
1. Mdt_test_G093T8U_08.lffs
2. Mdt_test_G095T6U_06.lffs

Step #	User Action	Expected Result	Pass = P Fail = X
1.	Carry out Test Case T-02 Steps 1 – 8 using "mdt_test_G093T8U_08.lffs" for both the Baseline and Comparison file inputs.		
2.	a. Move the mouse cursor over one of the baseline minutia marks. b. Click the left mouse button.	The mark changes color from red to blue. X, Y, and Theta values automatically populate the "Baseline Marker" fields.	P
3.	a. Move the mouse cursor over the same minutia mark on the comparison image. b. Click the left mouse button.	The mark changes color from red to blue. X, Y, and Theta values automatically populate the "Comparison Marker" fields.	P
4.	Click *Mate Marker Pair* in the "Deviation" window.	The "Mated" window is updated with the minutiae pair and their details.	P
5.	Repeat Steps 2 – 4 for all remaining minutiae and core markers selecting the identical mark on both Baseline and Comparison images.	The "Mated" window is updated with the minutiae pairs and their details.	P
6.	In the "Mated" window, confirm the Baseline and Comparison marks have the correct details.	The "Mated" window lists the minutiae marks listed in the "mdt_test_G093T8U_08.lffs" column of Table 1 for Baseline and Comparison. Note that the order will vary based on how the user selected the mated pairs.	P
7.	a. Click *File* → *Close Window*. b. When asked whether to "Save before closing session?" Click *No*.	The image display clears and resets to the initial MDT state.	P
8.	Repeat Steps 1 – 6 using "mdt_test_G095T6U_06.lffs" for both the Baseline and Comparison file inputs.	The "Mated" window lists the minutiae marks listed in the "mdt_test_G095T6U_06.lffs" column of Table 1 for Baseline and Comparison. Note that the order will vary based on how the user selected the mated pairs.	P

Results

PASSED: ☒ FAILED: ☐

Actual Results if Fail: N/A

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Tester's Name: Lars Ericson	**Date/Time:** 2015-03-27 1052	**Actual time to complete:** 5 minutes
Comments: None		

4.1.7 Test Case 7: View EBTS Fields

MDT System Version 0.1.0 Test Case	
Test Case ID: T-07	**Test Item:** View EBTS Fields
Requirements Addressed: 29	
Test Case Description: Verify that the text fields of the Baseline and Comparison LFFS input files can be viewed in a pop-up window.	
Prerequisites	
Test Environment: Default	
Required Interfaces: MDT System	
Assumptions: N/A	
Test Inputs: Files located in the "\MDTTool\TestData" 1. Mdt_test_G093T8U_08.lffs	

Step #	User Action	Expected Result	Pass = P Fail = X
1.	Carry out Test Case T-02 Steps 1 – 8 using "mdt_test_G093T8U_08.lffs" for both the Baseline and Comparison file inputs.		
2.	Click *File* → *Summary* → *Summary Baseline*	a. A pop-up window will appear titled "mdt_test_G093T8U_08.lffs" that displays the records of an EBTS files. b. The display lists the fields and their values, as depicted in Figure 4 and Figure 5.	P
3.	Confirm EBTS Viewer is displaying EBTS fields correctly.	The EBTS field values displayed in the viewer match the field values displayed in the ANSI/NIST EBTS Viewer shown in Figure 6, Figure 7, and Figure 8. Note that the MDT EBTS Viewer only displays the field values (highlighted)	P

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		and truncates subfield values into a comma-separated list within a field.	
4.	a. Close the pop-up window. b. Click *File* → *Summary* → *Summary Comparison*	a. A pop-up window will appear titled "mdt_test_G093T8U_08.lffs" that displays the records of an EBTS files. b. The display lists the fields and their values, as depicted in Figure 4 and Figure 5.	P
3.	Confirm EBTS Viewer is displaying EBTS fields correctly.	The EBTS field values displayed in the viewer match the field values displayed in the ANSI/NIST EBTS Viewer shown in Figure 6, Figure 7, and Figure 8.	P

Results		
PASSED: ☒ FAILED: ☐		
Actual Results if Fail: N/A		
Tester's Name: Lars Ericson	**Date/Time:** 2015-03-27 1056	**Actual time to complete:** 4 minutes
Comments: None		

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```
File
Record Type 1:
        Record Format: ASCII
        1.1: 196
        1.2: 0400
        1.3: 1, 3
        1.3: 2, 00

        1.3: 9, 01

        1.3: 13, 01

        1.4: LFFS
        1.5: 20150105
        1.6: 2
        1.9: 201501050240311481
        1.11: 19.69
        1.12: 19.69
        1.13: NORAM, EBTS 9.4
        1.14: 20150105074031Z
        1.15: 000, ASCII
        1.16: FBI, EBTS, 9.4

Record Type 2:
        Record Format: ASCII
        2.1: 114
        2.2: 00
        2.6: !!mdt_test_G093T8U_08
        2.11: 00
        2.34: 00, UC
        2.74: 00
        2.79: 20
        2.83: N
        2.95: N
        2.98: 1
        2.98: 2


Record Type 9:
        Record Format: ASCII
        9.1: 1229
        9.2: 01
        9.3: 6
        9.4: U
        9.300: 4059, 3896, 0000, 0000, 0,0-4059,0-4059,3896-0,3896
        9.301: 0, 15
        9.302: 00
        9.303: 2
        9.307: UC
        9.320: 01859, 01265, 0243, 000, 000
```

Figure 4: MDT EBTS Viewer for mdt_test_G093T8U_08.lffs (p. 1)

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```
        9.320: 01859, 01265, 0243, 000, 000
        9.321: 02657, 01717, 100, 225, 328, 000, 000, 000, 000
        9.331: 01641, 01814, 028, E, 000, 000
        9.331: 02200, 00889, 133, E, 000, 000

        9.331: 02311, 01123, 276, B, 000, 000

        9.331: 01427, 01646, 232, B, 000, 000

        9.901: 1/5/2015 14:40:31 - Created new LFFS transaction
        9.901: 1/5/2015 14:40:35 - Image MD5 hash: 266CC8FD 7EFE746E 56992D41 8B10FB12

        9.901: 1/5/2015 14:40:35 - Imported image file C:\Users\lmericson\Documents\+NIJ SSBT CoE\Task

        9.901: 1/5/2015 14:42:26 - AFIS Type: Extended Feature Set

        9.901: 1/5/2015 14:42:26 - Pattern Class: Unable to Classify

        9.901: 1/5/2015 14:42:26 - Orientation: 0 ?15 degrees

        9.901: 1/5/2015 14:42:26 - Tonal Reversal: No

        9.901: 1/5/2015 14:42:26 - Minutiae:  4 (0 hidden due to min reliability threshold of 0%)

        9.901: 1/5/2015 14:42:26 - Ridge Counts Manually Checked: No

        9.901: 1/5/2015 14:42:26 - Cores:  1

        9.901: 1/5/2015 14:42:26 - Delta:  1

        9.901: 1/5/2015 14:42:26 - Skeletonized Image: No

        9.901: 1/5/2015 14:42:26 - Saved file C:\Users\lmericson\Documents\+NIJ SSBT CoE\Task - Fingerpri


Record Type 13:
        Record Format: ASCIIBINARY
        13.1: 614540
        13.2: 01
        13.3: 6
        13.5: 20150105
        13.6: 800
        13.7: 768
        13.8: 1
        13.9: 500
        13.10: 500
        13.11: NONE
        13.12: 8
        13.13: 0
        13.999: Binary Data Field
```

Figure 5: MDT EBTS Viewer for mdt_test_G093T8U_08.lffs (p. 2)

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```
                                mdt_test_G093T8U_08.txt
Data file: C:\Users\lmericson\Documents\+NIJ SSBT CoE\Task - Fingerprint
Collection\CFP Phase 2\STD Test Data\mdt_test_G093T8U_08.lffs

Number of records:
  1 Type-1
  1 Type-2
  1 Type-9
  1 Type-13

Record 1: Transaction Information
  1.01                        Record Length      LEN    196
  1.02                              Version      VER    0400
  1.03                         File Content      CNT
     a                        Record Number           1 1
     b                                  IDC           1 3
     a                        Record Number           2 2
     b                                  IDC           2 00
     a                        Record Number           3 9
     b                                  IDC           3 01
     a                        Record Number           4 13
     b                                  IDC           4 01
  1.04                  Type of Transaction      TOT    LFFS
  1.05                                 Date      DAT    Jan 05,2015
  1.06                Transaction Priority      PRY    2 {Routine}
  1.09              Transaction Control Num      TCN    201501050240311481
  1.11           Native Scanning Resolution      NSR    19.69
  1.12             Nominal Trans Resolution      NTR    19.69
  1.13                          Domain Name      DOM
     a   Agency, Entity, or Implementation           1 NORAM
     b                Implementation Version         1 EBTS 9.4
  1.14                 Greenwich Mean Time      GMT    20150105074031Z
  1.15          Directory of Character Sets      DCS
     a                                Index           1 000
     b                                 Name           1 ASCII
     c                              Version           1
  1.16   Application Profile Specification      APS
     a    Application Profile Organization           1 FBI
     b             Application Profile Name           1 EBTS
     c  Application Profile Version Number           1 9.4

Record 2: Descriptive Text
 2.001                        Record Length      LEN    114
 2.002                 Image/Rec Designator      IDC    00
 2.006                  Attention Indicator      ATN    !!mdt_test_G093T8U_08
 2.011        Contributor Case ID Extension      CIX    00
 2.034         Pattern Level Classification      PAT
     a                        Finger Number           1 00
     b          Pattern Classification Code           1 UC {Unable to Class}
     c                          Reference 1           1
     d                          Reference 2           1
 2.074                       Finger Position      FGP  1 00 {Unknown}
 2.079       Number of Candidates Requested      NCR    20
 2.083          Add to Unsolved Latent File      ULF    N {No}
 2.095              Request Features Record      RFR    No
 2.098         Name of Designated Repository      NDR  1 1 {Criminal Master File
Records}
                                                       2 2 {Civil Records}

Record 9: Fingerprint Feature Data
 9.001                        Record Length      LEN    1229
 9.002                 Image/Rec Designator      IDC    01
 9.003                      Impression Type      IMP    6 {Latent photo}
 9.004                      Minutiae Format      FMT    U
                                   Page 1
```

Figure 6: ANSI/NIST EBTS Viewer for mdt_test_G093T8U_08.lffs (p. 1)

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```
                                mdt_test_G093T8U_08.txt
9.300                   Region of Interest      ROI
    a                                Width           1 4059
    b                               Height           1 3896
    c                    Horizontal Offset           1 0000
    d                      Vertical Offset           1 0000
    e                              Polygon           1 0,0-4059,0-4059,3896-0,3896
9.301                        Orientation      ORT
    a                          Direction           1 0
    b                        Uncertainty           1 15
9.302              Finger/Palm Position(s)      FPP
    a                       Position Code           1 00
    b                      Finger segment           1
    c     Off-Center Fingerprint Position           1
    d                              Polygon           1
9.303              EFS Feature Set Profile           1 2
9.307               Pattern Classification      PAT
    a               General Classification           1 UC
    b                    Subclassification           1
    c                   Delta relationship           1
9.320                                Cores      COR
    a                                    X           1 01859
    b                                    Y           1 01265
    c                            Direction           1 0243
    d      Radius of Position Uncertainty           1 000
    e                Direction Uncertainty           1 000
9.321                               Deltas      DEL
    a                                    X           1 02657
    b                                    Y           1 01717
    c                         Direction up           1 100
    d                       Direction left           1 225
    e                      Direction right           1 328
    f                                 Type           1
    g      Radius of Position Uncertainty           1 000
    h            Direction Uncertainty up           1 000
    i          Direction Uncertainty left           1 000
    j         Direction Uncertainty right           1 000
9.331                             Minutiae      MIN
    a                                    X           1 01641
    b                                    Y           1 01814
    c                                Theta           1 028
    d                                 Type           1 E
    e      Radius of Position Uncertainty           1 000
    f                Direction Uncertainty           1 000
    a                                    X           2 02200
    b                                    Y           2 00889
    c                                Theta           2 133
    d                                 Type           2 E
    e      Radius of Position Uncertainty           2 000
    f                Direction Uncertainty           2 000
    a                                    X           3 02311
    b                                    Y           3 01123
    c                                Theta           3 276
    d                                 Type           3 B
    e      Radius of Position Uncertainty           3 000
    f                Direction Uncertainty           3 000
    a                                    X           4 01427
    b                                    Y           4 01646
    c                                Theta           4 232
    d                                 Type           4 B
    e      Radius of Position Uncertainty           4 000
    f                Direction Uncertainty           4 000
9.901                          Annotations     NOTE  1 1/5/2015 14:40:31 - Created
new LFFS transaction
                                     Page 2
```

Figure 7: ANSI/NIST EBTS Viewer for mdt_test_G093T8U_08.lffs (p. 2)

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```
                                mdt_test_G093T8U_08.txt
                                                        2 1/5/2015 14:40:35 - Image MD5
hash: 266CC8FD 7EFE746E 56992D41 8B10FB12
                                                        3 1/5/2015 14:40:35 - Imported
image file C:\Users\lmericson\Documents\+NIJ SSBT CoE\Task - Fingerprint
Collection\CFP Phase 2\STD Test Data\mdt_test_G093T8U_08.bmp
                                                        4 1/5/2015 14:42:26 - AFIS
Type: Extended Feature Set
                                                        5 1/5/2015 14:42:26 - Pattern
Class: Unable to Classify
                                                        6 1/5/2015 14:42:26 -
Orientation: 0 ?15 degrees
                                                        7 1/5/2015 14:42:26 - Tonal
Reversal: No
                                                        8 1/5/2015 14:42:26 - Minutiae:
 4 (0 hidden due to min reliability threshold of 0%)
                                                        9 1/5/2015 14:42:26 - Ridge
Counts Manually Checked: No
                                                       10 1/5/2015 14:42:26 - Cores:  1
                                                       11 1/5/2015 14:42:26 - Delta:  1
                                                       12 1/5/2015 14:42:26 -
Skeletonized Image: No
                                                       13 1/5/2015 14:42:26 - Saved
file C:\Users\lmericson\Documents\+NIJ SSBT CoE\Task - Fingerprint Collection\CFP
Phase 2\STD Test Data\mdt_test_G093T8U_08.lffs without errors using ULW 6.4.1

Record 13: Latent Image
13.001              Logical Record Length      LEN  1 614540
13.002         Image Designation Character     IDC  1 01
13.003                   Impression Type       IMP  1 6 {Latent photo}
13.005                Latent Capture Date      LCD  1 Jan 05,2015
13.006             Horizontal Line Length      HLL  1 800
13.007               Vertical Line Length      VLL  1 768
13.008                        Scale Units      SLC  1 1
13.009             Horizontal Pixel Scale      HPS  1 500
13.010               Vertical Pixel Scale      VPS  1 500
13.011              Compression Algorithm      CGA  1 NONE
13.012                     Bits Per Pixel      BPX  1 8
13.013                    Finger Position      FGP  1 0
Unknown finger
Latent photo, Uncompressed image
Width: 800, Height: 768, Compression Rate: 1:1, Offset: 1678, Length: 614400,  IDC:
1
ANSI/NIST Image 1 MD5 hash: 266CC8FD 7EFE746E 56992D41 8B10FB12
```

Figure 8: ANSI/NIST EBTS Viewer for mdt_test_G093T8U_08.lffs (p. 3)

4.1.8 Test Case 8: Change Center Point

MDT System Version 0.1.0 Test Case	
Test Case ID: T-08	**Test Item:** Change Center Point
Requirements Addressed: 05	
Test Case Description: Verify that the center points of the images can be changed and updated.	
Prerequisites	
Test Environment: Default	
Required Interfaces: MDT System	
Assumptions: N/A	

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Test Inputs: Files located in the "\MDTTool\TestData"

1. Mdt_test_G093T8U_08.lffs
2. Mdt_test_G095T6U_06.lffs
3. Mdt_test03.mdts (optional)

Step #	User Action	Expected Result	Pass = P Fail = X
1.	Carry out Test Case T-04 or *Open* "mdt_test03.mdts".		
2.	Click *Adjust Center Markers* → *Adjust Baseline Center*.	A pop-up window will appear displaying the current X, Y, and ϕ coordinates of the baseline center point (X=400, Y=384, ϕ=0).	P
3.	Click *Left* five times.	The X value decreases by 1 with each click, ending in X=395.	P
4.	Click *Right* ten times.	The X value increases by 1 with each click, end in X=405.	P
5.	Click *Up* five times.	The Y value decreases by 1 with each click, ending in X=379.	P
6.	Click *Down* ten times.	The X value increases by 1 with each click, ending in X=389.	P
7.	Click *CCW* 35 times.	The Degree value increases by 1 with each click, ending in Degree=35.	P
8.	Click *CW* five times.	The Degree value decreases by 1 with each click, ending in Degree=30.	P
9.	Click *Update Center*.	The pop-up window disappears and the Baseline Data: Center values change from (X=2032, Y=1950, ϕ =0) to (X=2057, Y=1976, ϕ =30).	P
10.	Click *Adjust Center Markers* → *Adjust Comparison Center*.	A pop-up window will appear displaying the current X, Y, and ϕ coordinates of the comparison center point (X=400, Y=384, ϕ=0).	P
11.	Click *Right* five times.	The X value decreases by 1 with each click, ending in X=405.	P
12.	Click *Left* ten times.	The X value increases by 1 with each click, end in X=395.	P
13.	Click *Down* five times.	The Y value decreases by 1 with each click, ending in X=389.	P
14.	Click *Up* ten times.	The X value increases by 1 with each click, end in X=379.	P
15.	Click *CCW* 15 times.	The Degree value increases by 1 with each click, ending in Degree=15.	P
16.	Click *CW* five times.	The Degree value decreases by 1 with each click, ending in Degree=10.	P

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17.	Click *Update Center*.	The pop-up window disappears and the Baseline Data: Center values change from (X=2032, Y=1950, ϕ =0) to (X=2006, Y=1925, ϕ =10).	P
18.	Click *File* → *Save As.*	A pop-up window will appear titled "Save As" showing a location on the local computer within Windows Explorer. The "File name" field will be populated with "MDTsession<*date_time*>.mdts", where <*date_time*> is the date and time of the action.	P
19.	a. Navigate to \MDTTool\TestData within Windows Explorer. b. Delete the filename and enter "mdt_test08.mdts" as a new filename. c. Click *Save.*	The window closes and no changes to the MDT GUI occur.	P

Results		
PASSED: ☒ FAILED: ☐		
Actual Results if Fail: <*Enter the actual results if test fails*>		
Tester's Name: Lars Ericson	**Date/Time:** 2015-03-27 1059	**Actual time to complete:** 3 minutes
Comments: None		

4.2 Calculate Minutiae Deviations

Capability: The MDT calculates the spatial deviations between a pair of minutiae selected on the *Baseline Fingerprint* and *Comparison Fingerprint.* The user selects two minutiae and upon selection, the spatial deviations are automatically displayed in the deviation region of the GUI. The user then has the option to save the pairing by clicking on a button. If the minutia pair is saved, then the previously selected minutia will change color to Green. Either minutia can be unselected by clicking on them again with the mouse cursor.

4.2.1 Test Case 9: Select Minutiae Pair with Cartesian Deviations

MDT System Version 0.1.0 Test Case	
Test Case ID: T-09	**Test Item:** Select Minutiae Pair with Cartesian Deviations
Requirements Addressed: 04, 05, 06	

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Test Case Description: Verify that deviations are calculated correctly using Cartesian coordinates for a pair of selected minutiae and displayed in the GUI.

Prerequisites

Test Environment: Default

Required Interfaces: MDT System

Assumptions: N/A

Test Inputs: Files located in the "\MDTTool\TestData"
1. Mdt_test_G093T8U_08.lffs
2. Mdt_test_G095T6U_06.lffs
3. Mdt_test08.mdts (optional)

Step #	User Action	Expected Result	Pass = P Fail = X
1.	Carry out Test Case T-08 or *Open* "mdt_test08.mdts".		
2.	a. Move the mouse cursor over the left most minutia mark of the baseline image. b. Click the left mouse button.	The mark changes color from red to blue. X, Y, and Theta values automatically populate the "Baseline Marker" fields with (X=1427, Y=1646, Θ=232, Type=Bifurcation).	P
3.	a. Move the mouse cursor over the upper left most (non-delta) minutia mark on the comparison image. b. Click the left mouse button.	The mark changes color from red to blue. X, Y, and Theta values automatically populate the "Comparison Marker" fields with (X=1509, Y=1666, Θ=254, Type=Bifurcation).	P
4.	Confirm relative deviation calculations are displayed.	The "Deviation" window displays the following "Relative Deviation (Marker)": Δ (X=82, Y=20, Θ=22°)	P
5.	Confirm absolute deviation calculations are displayed.	The "Deviation" window displays the following "Absolute Deviation (Center)": Δ (X=-64, Y=259, Θ=42°)	P
6.	Click *Mate Marker Pair* in the "Deviation" window.	a. The "Mated" window is updated to list "(1427,1646)@232° type=Bifurcation RPU=0" under the BaseLine column and "(1509,1666)@254° type=Bifurcation RPU=0" under the Comparison column. b. The marks change color to green. c. The deviation values in the "Deviation" window revert to blank.	P

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7.	a. Move the mouse cursor over the upper most minutia mark of the baseline image. b. Click the left mouse button.	The mark changes color from red to blue. X, Y, and Theta values automatically populate the "Baseline Marker" fields with (X=2200, Y=889, Θ=133, Type=RidgeEnding).	P
8.	a. Move the mouse cursor over the lower right most minutia mark on the comparison image. b. Click the left mouse button.	The mark changes color from red to blue. X, Y, and Theta values automatically populate the "Comparison Marker" fields with (X=2840, Y=2677, Θ=15, Type=Bifurcation).	P
9.	Confirm relative deviation calculations are displayed.	The "Deviation" window displays the following "Relative Deviation (Marker)": Δ (X=640, Y=1788, Θ=242°)	P
10.	Confirm absolute deviation calculations are displayed.	The "Deviation" window displays the following "Absolute Deviation (Center)": Δ (X=23, Y=1754, Θ=262°)	P
11.	Click *Mate Marker Pair* in the "Deviation" window.	a. The "Mated" window is updated to list "(2200,889)@133° type=RidgeEnding RPU=0" under the BaseLine column and "(2840,2677)@15° type=Bifurcation RPU=0" under the Comparison column. b. The marks change color to green. c. The deviation values in the "Deviation" window revert to blank.	P
12.	a. Move the mouse cursor over the right center (non-delta) minutia mark of the baseline image. b. Click the left mouse button.	The mark changes color from red to blue. X, Y, and Theta values automatically populate the "Baseline Marker" fields with (X=2311, Y=1123, Θ=276, Type=Bifurcation).	P
13.	a. Move the mouse cursor over the lower center minutia mark on the comparison image. b. Click the left mouse button.	The mark changes color from red to blue. X, Y, and Theta values automatically populate the "Comparison Marker" fields with (X=1905, Y=2266, Θ=12, Type=RidgeEnding).	P
14.	Confirm relative deviation calculations are displayed.	The "Deviation" window displays the following "Relative Deviation (Marker)": Δ (X=-406, Y=1143, Θ=96°)	P
15.	Confirm absolute deviation calculations are displayed.	The "Deviation" window displays the following "Absolute Deviation (Center)": Δ (X=-804, Y=929, Θ=116°)	P
16.	Click *Mate Marker Pair* in the "Deviation" window.	a. The "Mated" window is updated to list "(2311,1123)@276° type=Bifurcation	P

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		RPU=0" under the BaseLine column and "(1905,2266)@12° type=RidgeEnding RPU=0" under the Comparison column. b. The marks change color to green. c. The deviation values in the "Deviation" window revert to blank.	
17.	Click *File* → *Save As.*	A pop-up window will appear titled "Save As" showing a location on the local computer within Windows Explorer. The "File name" field will be populated with "MDTsession<*date_time*>.mdts", where <*date_time*> is the date and time of the action.	P
18.	a. Navigate to \MDTTool\TestData within Windows Explorer. b. Delete the filename and enter "mdt_test09.mdts" as a new filename. c. Click *Save.*	The window closes and no changes to the MDT GUI occur.	P

Results		
PASSED: ☒ FAILED: ☐		
Actual Results if Fail: N/A		
Tester's Name: Lars Ericson	**Date/Time:** 2015-03-27 1103	**Actual time to complete:** 3 minutes
Comments: None		

4.3 Exporting Logs and EBTS Files

Capability: The MDT allows a user to export logs and EBTS files from the current session. The original Baseline or Comparison fingerprint image and minutiae can be exported as an LFFS EBTS file. These actions write the internal MDT database fields associated with the EBTS fields to a new LFFS output file. All fields are unchanged from when they were originally input to MDT. The MDT allows a user to export a *Deviation Log* as a text file containing a log of minutiae pairs with their characteristic details and the resulting deviation calculations from the current user session. The text file is in a table structured format suitable for viewing in a common office spreadsheet software program (e.g., MS Excel). The MDT allows a user to export the *History Log* as an unstructured text file containing a log of any actions taken within the session by the user that resulted in a change state.

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4.3.1 Test Case 10: Export Deviation Log

MDT System Version 0.1.0 Test Case	
Test Case ID: T-10	**Test Item:** Export Deviation Log
Requirements Addressed: 14	
Test Case Description: Verify that a text file containing mated minutia pairs and their calculated Cartesian deviations can be exported and saved.	
Prerequisites	
Test Environment: Default	
Required Interfaces: MDT System	
Assumptions: N/A	
Test Inputs: Files located in the "\MDTTool\TestData" 1. Mdt_test_G093T8U_08.lffs 2. Mdt_test_G095T6U_06.lffs 3. Mdt_test09.mdts (optional)	

Step #	User Action	Expected Result	Pass = P Fail = X
1.	Carry out Test Case T-09 or *Open* "mdt_test09.mdts".		
2.	Click *Export* → *Export Complete Deviation Log (CSV).*	A pop-up window will appear titled "Deviation FilterWindow" with a drop down menu listing the available deviation modules. The drop down menu defaults to listing "Cartesian Deviation Calculation."	P
2.	Click *OK.*	A pop-up window will appear titled "Save As" showing a location on the local computer within Windows Explorer. The "File name" field will be populated with "mdt_test09.mdt.csv".	P
3.	a. Navigate to \MDTTool\TestData within Windows Explorer. b. Click *Save*.	The window closes and after a couple seconds a small pop-up window will display "Export Completed."	P
4.	Click *OK.*	The pop-up window closes returning the user to the main MDT GUI.	P
5.	a. Exit MDT. b. Locate \MDTTool\TestData on the local computer.	A file opens containing a table of minutia pair details and their calculated deviations. Confirm the	P

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	c. Open "mdt_test09.mdt.csv" with a spreadsheet program (e.g., MS Excel).	content by comparing the log file with Figure 9.	

Results

PASSED: ☒ FAILED: ☐

Actual Results if Fail: N/A

Tester's Name:	**Date/Time:**	**Actual time to complete:**
Lars Ericson	2015-03-27 1105	2 minutes

Comments: None

Baseline X	Baseline Y	Baseline Theta	Baseline Minutiae Type	Comparison X	Comparison Y	Comparison Theta	Comparison MinutiaeType	Baseline Center X	Baseline Center Y	Baseline Center Theta
1427	1646	232	Bifurcatior	1509	1666	254	Bifurcation	2057	1976	30
2200	889	133	RidgeEndir	2840	2677	15	Bifurcation	2057	1976	30
2311	1123	276	Bifurcatior	1905	2266	12	RidgeEnding	2057	1976	30

Comparison Center X	Comparison Center Y	Comparison Center Theta	RelativeDeviation DeltaX	RelativeDeviation DeltaY	RelativeDeviation DeltaTheta	Absolute Devation DeltaX	AbsoluteDevation DeltaY	Absolute Devation DeltaTheta	Absolute Devation DeltaDistance
2006	1925	10	82	20	22	-64	259	42	266
2006	1925	10	640	1788	242	23	1754	262	1754
2006	1925	10	-406	1143	96	-804	929	116	1228

Figure 9: Export of MDT Deviation Log
Note that the rows have been cut in half and stacked for visual purposes. The CSV file will have four long rows.

4.3.2 Test Case 11: Export History

MDT System Version 0.1.0 Test Case

Test Case ID: T-11	**Test Item:** Export History

Requirements Addressed: 30

Test Case Description: Verify that the log of actions taken in an MDT session can be exported and saved as a text file.

Prerequisites

Test Environment: Default

Required Interfaces: MDT System

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Assumptions: N/A

Test Inputs: Files located in the "\MDTTool\TestData"

1. Mdt_test_G093T8U_08.lffs
2. Mdt_test_G095T6U_06.lffs
3. Mdt_test09.mdts (optional)

Step #	User Action	Expected Result	Pass = P Fail = X
1.	Carry out Test Case T-09 or *Open* "mdt_test09.mdts".		
2.	Click *Export* → *Export History Logs.*	A pop-up window will appear titled "Save As" showing a location on the local computer within Windows Explorer. The "File name" field will be populated with "mdt_test09.log".	P
3.	a. Navigate to \MDTTool\TestData within Windows Explorer. b. Click *Save*.	The window closes and the MDT GUI updates to show the saved filename at the top of the main display window.	P
4.	a. Exit MDT. b. Locate \MDTTool\TestData on the local computer. c. Open "mdt_test09.log" with a text viewer (e.g., Notepad).	A text file opens containing a line item listing of all actions taken within the MDT session. Confirm the content by comparing the log file with Figure 10.	P

Results

PASSED: ☒ FAILED: ☐

Actual Results if Fail: N/A

Tester's Name:	**Date/Time:**	**Actual time to complete:**
Lars Ericson	2015-03-27 1118	1 minute

Comments: None

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```
[3/5/2015 7:53:19 PM] New Session Loaded
[3/5/2015 7:53:19 PM] Loading Baseline: C:\Users\lmericson\Documents\+NIJ SSBT CoE\Task -
Fingerprint Collection\CFP Phase 2\Task 1b - Deviation Analysis\STD Test Data
\mdt_test_G093T8U_08.lffs
[3/5/2015 7:53:23 PM] Baseline Load: Success
[3/5/2015 7:53:23 PM] Loading Comparison: C:\Users\lmericson\Documents\+NIJ SSBT CoE\Task -
Fingerprint Collection\CFP Phase 2\Task 1b - Deviation Analysis\STD Test Data
\mdt_test_G095T6U_06.lffs
[3/5/2015 7:53:24 PM] Comparison Load: Success
[3/5/2015 7:57:15 PM] Session Saved
[3/17/2015 3:14:15 PM] Session Loaded
[3/17/2015 3:15:36 PM] ---------------------------------------------------
[3/17/2015 3:15:36 PM] MarkerPair Deviation Calculation
[3/17/2015 3:15:36 PM] Minutiae (1427,1646)@232° type=Bifurcation RPU=0
[3/17/2015 3:15:36 PM] Minutiae (1509,1666)@254° type=Bifurcation RPU=0
[3/17/2015 3:15:36 PM] Relative Deviation:Cartesian Δ (X,Y,θ) = (82,20,22°)
[3/17/2015 3:15:36 PM] Absolute Deviation:Cartesian Δ (X,Y,θ) = (-64,259,42°)
[3/17/2015 3:16:00 PM] Mated: Minutiae (1427,1646)@232° type=Bifurcation RPU=0, Minutiae
(1509,1666)@254° type=Bifurcation RPU=0
[3/17/2015 3:16:11 PM] ---------------------------------------------------
[3/17/2015 3:16:11 PM] MarkerPair Deviation Calculation
[3/17/2015 3:16:11 PM] Minutiae (2200,889)@133° type=RidgeEnding RPU=0
[3/17/2015 3:16:11 PM] Minutiae (2840,2677)@15° type=Bifurcation RPU=0
[3/17/2015 3:16:11 PM] Relative Deviation:Cartesian Δ (X,Y,θ) = (640,1788,242°)
[3/17/2015 3:16:11 PM] Absolute Deviation:Cartesian Δ (X,Y,θ) = (23,1754,262°)
[3/17/2015 3:16:45 PM] Mated: Minutiae (2200,889)@133° type=RidgeEnding RPU=0, Minutiae
(2840,2677)@15° type=Bifurcation RPU=0
[3/17/2015 3:16:58 PM] ---------------------------------------------------
[3/17/2015 3:16:58 PM] MarkerPair Deviation Calculation
[3/17/2015 3:16:58 PM] Minutiae (2311,1123)@276° type=Bifurcation RPU=0
[3/17/2015 3:16:58 PM] Minutiae (1905,2266)@12° type=RidgeEnding RPU=0
[3/17/2015 3:16:58 PM] Relative Deviation:Cartesian Δ (X,Y,θ) = (-406,1143,96°)
[3/17/2015 3:16:58 PM] Absolute Deviation:Cartesian Δ (X,Y,θ) = (-804,929,116°)
[3/17/2015 3:17:13 PM] Mated: Minutiae (2311,1123)@276° type=Bifurcation RPU=0, Minutiae
(1905,2266)@12° type=RidgeEnding RPU=0
[3/17/2015 3:17:34 PM] Session Saved
```

Figure 10: Export of MDT History Log

4.3.3 Test Case 12: Export Original EBTS Files

MDT System Version 0.1.0 Test Case	
Test Case ID: T-12	**Test Item:** Export Original EBTS Files
Requirements Addressed: 09, 12	
Test Case Description: Verify that the original Baseline and Comparison fingerprint images and minutia sets can be exported and saved as EBTS LFFS files.	
Prerequisites	
Test Environment: Default	
Required Interfaces: MDT System	
Assumptions: N/A	
Test Inputs: Files located in the "\MDTTool\TestData" 1. Mdt_test_G093T8U_08.lffs 2. Mdt_test_G095T6U_06.lffs	

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3. Mdt_test08.mdts (optional)

Step #	User Action	Expected Result	Pass = P Fail = X
1.	Carry out Test Case T-08 or *Open* "mdt_test08.mdts".		
2.	Click *Export* → *Export Baseline Original File.*	A pop-up window will appear titled "Save As" showing a location on the local computer within Windows Explorer. The "File name" field will be populated with "mdt_test_G093T8U_08.lffs".	P
3.	a. Navigate to \MDTTool\TestData within Windows Explorer. b. Delete the filename and enter "mdt_test08_baseline.lffs" as a new filename. c. Click *Save.*	The window closes and no changes to the MDT GUI occur.	P
4.	Click *Export* → *Export Comparison Original File.*	A pop-up window will appear titled "Save As" showing a location on the local computer within Windows Explorer. The "File name" field will be populated with "mdt_test_G095T6U_06.lffs".	P
5.	a. Navigate to \MDTTool\TestData within Windows Explorer. b. Delete the filename and enter "mdt_test08_comparison.lffs" as a new filename. c. Click *Save.*	The window closes and no changes to the MDT GUI occur.	P
6.	a. Click *File* → *Close Window.* b. When asked whether to "Save before closing session?" Click *No.*	The image display clears and resets to the initial MDT state.	P
7.	Carry out Test Case T-02 Steps 2-8 using "mdt_test08_baseline.lffs" and "mdt_test08_comparison.lffs" as the baseline and comparison input files.	The pop-up window will close and the MDT GUI will update to show the two images and their minutiae sets in the pair of viewing windows. The Baseline display will appear the same as Figure 1. The Comparison display will appear the same as Figure 2.	P

Results

PASSED: ☒ FAILED: ☐

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Actual Results if Fail: N/A		
Tester's Name: Lars Ericson	**Date/Time:** 2015-03-27 1122	**Actual time to complete:** 4 minutes
Comments: None		

4.3 Filter Minutia Deviations

Capability: The MDT allows a user to filter minutiae by inputting threshold values to one or more minutia characteristic parameters and then export the results. To filter minutiae, the user selects whether to filter the Deviation Log, Baseline LFFS EBTS file, or Comparison LFFS EBTS file. The user interacts with a *DeviationFilterWindow* pop-up window listing all of the possible filter criteria. The user makes selections by clicking on radio buttons or entering threshold values for some of the fields, based on their desired effect or preference. Once all filter parameters have been set, the user clicks on the *OK* button at the bottom of the window. The MDT exports a file to markings satisfying those conditions.

4.3.1 Test Case 13: Export Filtered Deviation Log

MDT System Version 0.1.0 Test Case	
Test Case ID: T-13	**Test Item:** Export Filtered Deviation Log
Requirements Addressed: 07	
Test Case Description: Verify that deviations can be filtered based on deviation or position conditions and exported as a filtered deviation log in CSV format.	
Prerequisites	
Test Environment: Default	
Required Interfaces: MDT System	
Assumptions: N/A	
Test Inputs: Files located in the "\MDTTool\TestData" 1. Mdt_test_G093T8U_08.lffs 2. Mdt_test_G095T6U_06.lffs 3. Mdt_test09.mdts (optional)	

Step #	User Action	Expected Result	Pass = P Fail = X
1.	Carry out Test Case T-09 or *Open* "mdt_test09.mdts".		

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2.	Click *Export* → *Filter* → *Export Filtered Deviation Log (CSV)*	A pop-up window will appear titled "DeviationFilterWindow" that displays a range of filter options. A drop-down menu at the top will list *Cartesian Deviation Calculation* as the default setting. Confirm that the window shown is that shown in Figure 11.	P
3.	a. Click *Plug-in Information.* b. Click the "x" to remove the pop-up window.	A pop-up window will appear stating: "Plug-in Description Calculates marker deviation using Cartesian Coordinates".	P
4.	a. Change the filter criteria indicated for Test A in Table 3. b. Click *OK.*	The "DeviationFilterWindow" will close and a new pop-up window will appear showing a location on the local computer within Windows Explorer. The "File name" field will be populated with "mdt_test09.mdts.csv".	P
5.	a. Navigate to \MDTTool\TestData within Windows Explorer. b. Delete the filename and enter "mdt_test13_<letter>.csv" as a new filename, where <letter> is the set of test parameters from Table 3. c. Click *Save.*	The window closes and a pop-window appears titled "Success" stating "Export CSV Completed." No changes to the MDT GUI occur.	P
6.	Click *OK.*	The window closes and no changes to the MDT GUI occur.	P
7.	a. Locate \MDTTool\TestData on the local computer. b. Open "mdt_test13_<letter>.csv" with a spreadsheet program (e.g., MS Excel).	A file opens containing a table of minutia pair details and their calculated deviations. Confirm the content by comparing the log file with the minutia pairs in Table 2 and the expected results in Table 3.	Enter Pass/Fail in Table 3.
8.	Repeat Steps 2-7 for the remaining tests in Table 3.		Enter Pass/Fail for Step 7 in Table 3.

Results		
PASSED: ☒ FAILED: ☐		
Actual Results if Fail: N/A		
Tester's Name:	**Date/Time:**	**Actual time to complete:**

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Lars Ericson	2015-03-27 1139	17 minutes
Comments: None		

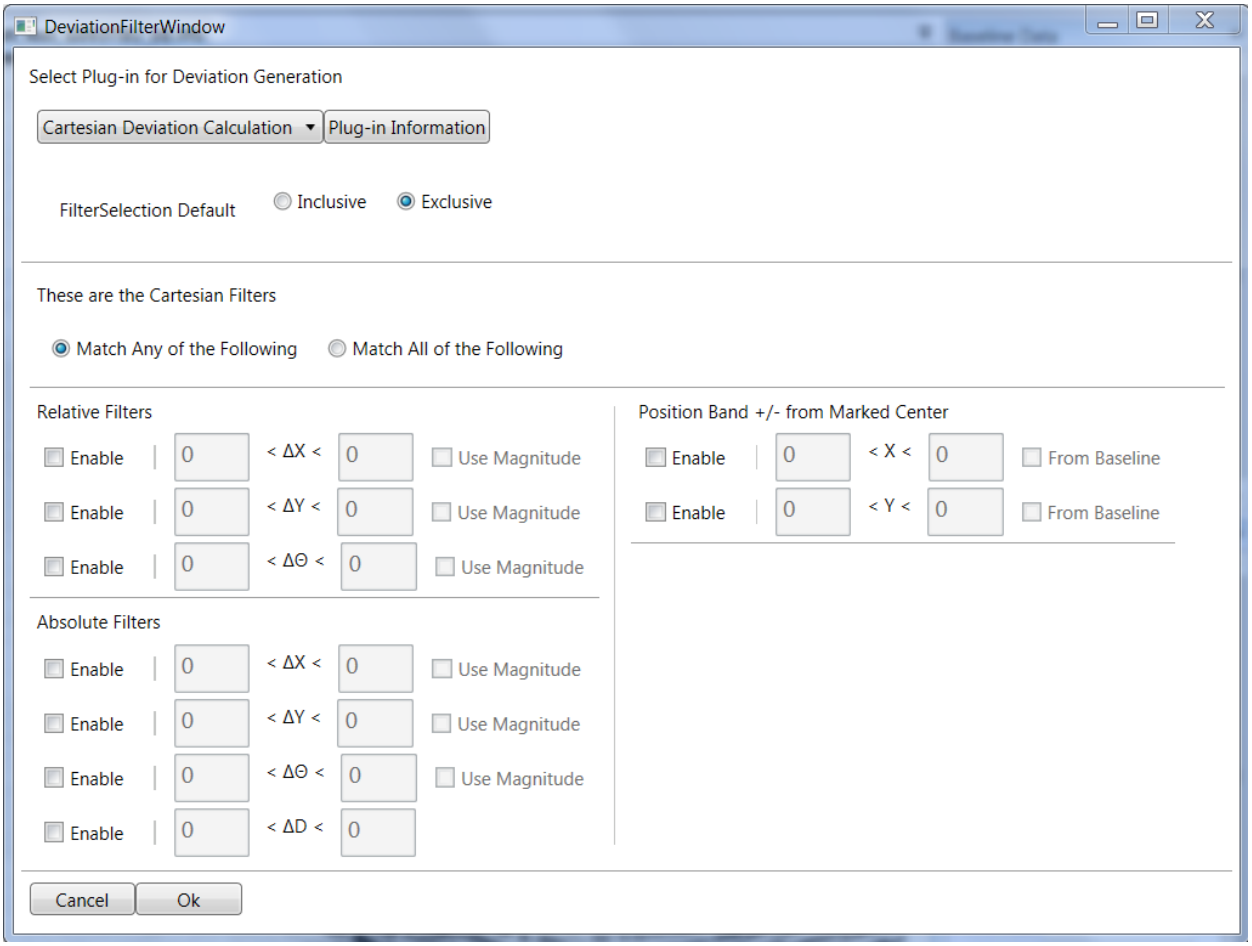

Figure 11: Deviation Filter Window

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Table 2: Full Deviation Log for mdt_test09.mdts

#	Baseline X	Baseline Y	Baseline Theta	Baseline MinutiaeType	Comparison X	Comparison Y	Comparison Theta
1	1427	1646	232	Bifurcation	1509	1666	254
2	2200	889	133	RidgeEnding	2840	2677	15
3	2311	1123	276	Bifurcation	1905	2266	12
#	Comparison MinutiaeType	BaselineCenter X	BaselineCenter Y	BaselineCenter Theta	Comparison Center X	Comparison Center Y	Comparison Center Theta
1	Bifurcation	2057	1976	30	2006	1925	10
2	Bifurcation	2057	1976	30	2006	1925	10
3	RidgeEnding	2057	1976	30	2006	1925	10
#	RelativeDeviation DeltaX	RelativeDeviation DeltaY	RelativeDeviation DeltaTheta	AbsoluteDevation DeltaX	AbsoluteDevation DeltaY	AbsoluteDevation DeltaTheta	AbsoluteDevation DeltaDistance
1	82	20	22	-64	259	42	266
2	640	1788	242	23	1754	262	1754
3	-406	1143	96	-804	929	116	1228

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Table 3: Test Parameters for Deviation Filter Tests

Test	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Match ANY / ALL	Any	Any	Any	Any	Any	Any	Any	All	Any	Any	Any	Any	Any	All	Any
Relative, ΔX, Range	0 600														
Relative, ΔX, Mag															
Relative, ΔY, Range		1500 2000													
Relative, ΔY, Mag															
Relative, ΔΘ, Range			90 270												
Relative, ΔΘ, Mag															
Absolute, ΔX, Range				0 100	0 100		0 100	0 100							
Absolute, ΔX, Mag					X										
Absolute, ΔY, Range						0 1000	0 1000	0 1000							
Absolute, ΔY, Mag															
Absolute, ΔΘ, Range									0 50						
Absolute, ΔΘ, Mag															
Absolute, D										1000 2000					
Position, ΔX, Range											0 650		0 650	0 650	
Position, ΔX, comparison															
Position, ΔY, Range												610 900	610 900	610 900	610 900
Position, ΔY, comparison															X
Deviation Pair #1	X				X	X	X		X		X		X		
Deviation Pair #2		X	X	X	X		X			X		X	X		X
Deviation Pair #3			X			X	X			X	X	X	X	X	
Deviation Log (T-13) Pass = P, Fail = F	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
Baseline EBTS (T-14) Pass = P, Fail = F	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
Comparison EBTS (T-14) Pass = P, Fail = F	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P

4.4.2 Test Case 14: Export Filtered EBTS

MDT System Version 0.1.0 Test Case	
Test Case ID: T-14	**Test Item:** Export Filtered EBTS
Requirements Addressed: 07, 09	
Test Case Description: Verify that the Baseline and Comparison fingerprint images and minutia sets can be exported and saved as EBTS LFFS files containing only minutiae that meet the filter criteria.	

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Prerequisites			
Test Environment: Default			
Required Interfaces: MDT System			
Assumptions: N/A			
Test Inputs: Files located in the "\MDTTool\TestData" 1. Mdt_test_G093T8U_08.lffs 2. Mdt_test_G095T6U_06.lffs 3. Mdt_test09.mdts (optional)			
Step #	**User Action**	**Expected Result**	**Pass = P Fail = X**
1.	Carry out Test Case T-09 or *Open* "mdt_test09.mdts".		
2.	Click *Export* → *Filter* → *Export Filtered Baseline LFFS*	A pop-up window will appear titled "DeviationFilterWindow" that displays a range of filter options. A drop-down menu at the top will list *Cartesian Deviation Calculation* as the default setting. Confirm that the window shown is that shown in Figure 11.	P
3.	a. Change the filter criteria indicated for Test A in Table 3. b. Click *OK.*	The "DeviationFilterWindow" will close and a new pop-up window will appear showing a location on the local computer within Windows Explorer. The "File name" field will be populated with "mdt_test_G093T8U_08_filtered.lffs"	P
4.	a. Navigate to \MDTTool\TestData within Windows Explorer. b. Delete the filename and enter "mdt_test13_base_<letter>.lffs" as a new filename, where <letter> is the set of test parameters from Table 3. c. Click *Save.*	The window closes and a pop-window appears titled "Success" stating "Export Baseline Completed." No changes to the MDT GUI occur.	P
5.	Click *OK.*	The window closes and no changes to the MDT GUI occur.	P
6.	Click *Export* → *Filter* → *Export Filtered Comparison LFFS*	A pop-up window will appear titled "DeviationFilterWindow" that displays a range of filter options. A drop-down menu at the top will list *Cartesian Deviation Calculation* as the default	P

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		setting. Confirm that the window shown is that shown in Figure 11.	
7.	a. Change the filter criteria indicated for Test A in Table 3. b. Click *OK.*	The "DeviationFilterWindow" will close and a new pop-up window will appear showing a location on the local computer within Windows Explorer. The "File name" field will be populated with "mdt_test_G095T6U_06_filtered.lffs"	P
8.	a. Navigate to \MDTTool\TestData within Windows Explorer. b. Delete the filename and enter "mdt_test13_comp_<letter>.lffs" as a new filename, where <letter> is the set of test parameters from Table 3. c. Click *Save.*	The window closes and a pop-window appears titled "Success" stating "Export Comparison Completed." No changes to the MDT GUI occur.	P
9.	Click *OK.*	The window closes and no changes to the MDT GUI occur.	P
10.	a. Click *File* → *Close Window.* b. When asked whether to "Save before closing session?" Click *No.*	The image display clears and resets to the initial MDT state.	P
11.	Carry out Test Case T-02 Steps 2-8 using "mdt_test09_base_<letter>.lffs" and "mdt_test09_comp_<letter>.lffs" as the baseline and comparison input files.	a. The pop-up window will close and the MDT GUI will update to show the two images and their filtered minutiae sets in the pair of viewing windows. b. Compare the baseline image and to Figure 12 and refer to Table 3 verify that the minutia pairs listed as expected outcomes for the given test are displayed. c. Compare the comparison image to Figure 12. Verify that the expected minutia pairs for the given test are displayed.	Enter Pass/Fail in Table 3 for both exported images.
12.	a. Click *File* → *Close Window.* b. When asked whether to "Save before closing session?" Click *No.*	The image display clears and resets to the initial MDT state.	P
13.	Repeat Steps 2-12 for the remaining tests in Table 3.		Enter Pass/Fail for Step 7 in Table 3.
Results			

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PASSED: ☒ FAILED: ☐		
Actual Results if Fail: N/A		
Tester's Name: Lars Ericson	**Date/Time:** 2015-03-27 1333	**Actual time to complete:** 25 minutes
Comments: None		

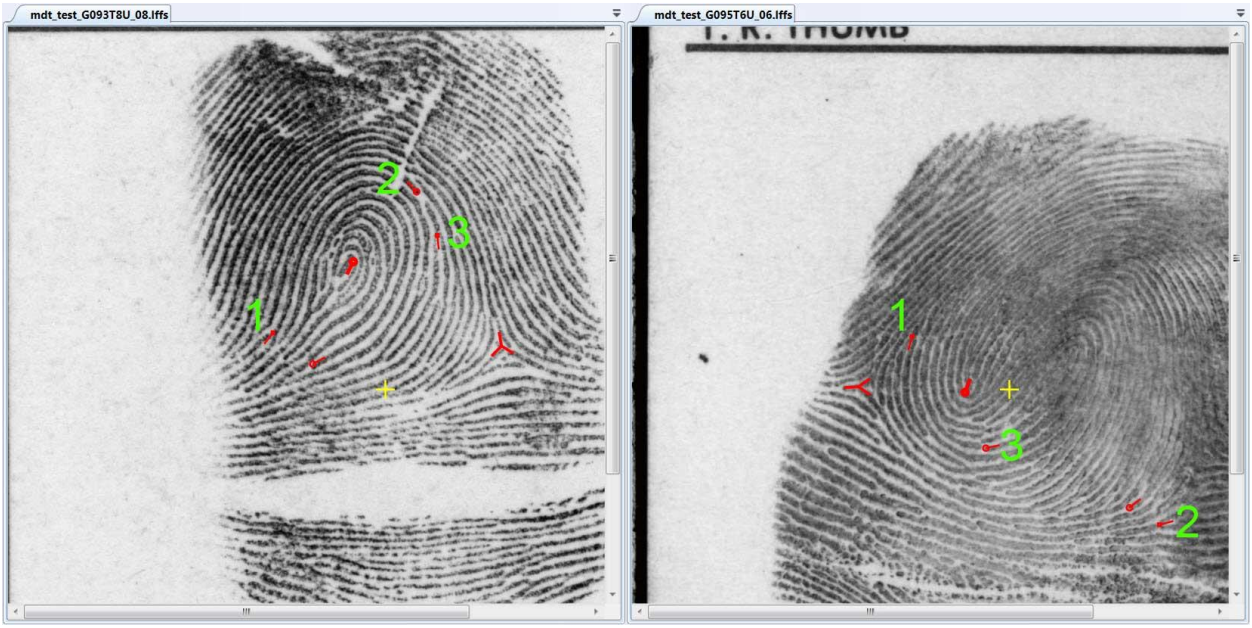

Figure 12: Mdt_test09.mdts Minutia Pairs
Minutia pairs defined in Test Case T-09 numbered for reference during filtering tests.

4.4.3 Test Case 15: Export Random Filtered Files

MDT System Version 0.1.0 Test Case	
Test Case ID: T-15	**Test Item:** Export Random Filtered Files
Requirements Addressed: 09	
Test Case Description: Verify that the Baseline and Comparison fingerprint images and minutia sets and the Deviation Log can be exported and saved as EBTS LFFS files and a CSV file containing a user-selected number of randomly selected minutia pairs.	
Prerequisites	
Test Environment: Default	
Required Interfaces: MDT System	

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Assumptions: N/A

Test Inputs: Files located in the "\MDTTool\TestData"
1. Mdt_test_G093T8U_08.lffs
2. Mdt_test_G095T6U_06.lffs
3. Mdt_test09.mdts (optional)

Step #	User Action	Expected Result	Pass = P Fail = X
1.	Carry out Test Case T-09 or *Open* "mdt_test09.mdts".		
2.	Click *Export* → *Filter* → *Export Filtered Deviation Log (CSV)*	A pop-up window will appear titled "DeviationFilterWindow" that displays a range of filter options.	P
3.	a. Click the drop-down menu currently displaying "Cartesian Deviation Calculation". b. Select "Random Selection".	The filter options in the window will change to showing the random filter text.	P
4.	a. In the field titled "Number of random Minutiae to select," change the field from "0" to "2". b. Click *OK.*	The *DeviationFilterWindow* window will go away and a pop-up window will appear with the following message: "The Selected plug-in required Saving of CSV/LFFS Files together to ensure correct output.	P
5.	a. Click *OK.*	The message window will close and a new pop-up window will appear showing a location on the local computer within Windows Explorer. The "File name" field will be populated with "mdt_test09.mdts.csv".	P
6.	a. Navigate to \MDTTool\TestData within Windows Explorer. b. Delete the filename and enter "mdt_test15_random.csv" as a new filename. c. Click *Save.*	The window closes and a pop-window appears titled "Success" stating "Export CSV Completed."	P
7.	a. Click *OK.*	The message window will close and a new pop-up window will appear showing a location on the local computer within Windows Explorer. The "File name" field will be populated with "mdt_test_G093T8U_08_filtered.csv".	P
8.	a. Navigate to \MDTTool\TestData within	The window closes and a pop-window appears titled "Success" stating "Export	P

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	Windows Explorer. b. Delete the filename and enter "mdt_test15_baseline.lffs" as a new filename. c. Click *Save.*	Baseline Completed."	
9.	a. Click *OK.*	The message window will close and a new pop-up window will appear showing a location on the local computer within Windows Explorer. The "File name" field will be populated with "mdt_test_G095T6U_06_filtered.csv".	P
10.	a. Navigate to \MDTTool\TestData within Windows Explorer. b. Delete the filename and enter "mdt_test15_comparison.lffs" as a new filename. c. Click *Save.*	The window closes and a pop-window appears titled "Success" stating "Export Comparison Completed."	P
11.	a. Click *OK.*	The message window will close. No changes will occur to the MDT GUI view.	P
12.	a. Click *File* → *Close Window.* b. When asked whether to "Save before closing session?" Click *No.*	The image display clears and resets to the initial MDT state.	P
13.	Carry out Test Case T-02 Steps 2-8 using "mdt_test15_baseline.lffs" and "mdt_test15_comparison.lffs" as the baseline and comparison input files.	The pop-up window will close and the MDT GUI will update to show the two images and their minutiae sets in the pair of viewing windows. The Baseline display will appear the same as Figure 1, but with only two minutiae and the delta markings. The Comparison display will appear the same as Figure 2, but with only two minutiae and the delta markings.	P
14.	a. Locate \MDTTool\TestData on the local computer. b. Open "mdt_test09_random.csv" with a spreadsheet program (e.g., MS Excel).	A file opens containing a table of minutia pair details and their calculated deviations. Confirm that two minutia pairs and their deviations are listed.	P
15.	In the Baseline image, click on one of the minutia markings with the mouse.	a. The "Baseline Marker" portion of the center GUI region updates with (X, Y,Θ) values for the minutia. b. Confirm that the (X, Y,Θ) values are listed in the "mdt_test15_random.csv"	P

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		table under (Baseline X, Baseline Y, Baseline Theta).	
16.	Repeat Step 15 for the second minutia mark.	Confirm that the (X, Y,Θ) values are listed in the "mdt_test15_random.csv" table under (Baseline X, Baseline Y, Baseline Theta).	P
17.	Repeat Step 15 for the Comparison image and its two minutia markings.	Confirm that the (X, Y,Θ) values are listed in the "mdt_test15_random.csv" table under (Comparison X, Comparison Y, Comparison Theta).	P

Results

PASSED: ☒ FAILED: ☐

Actual Results if Fail: N/A

Tester's Name:	**Date/Time:**	**Actual time to complete:**
Lars Ericson	2015-03-27 1338	5 minutes

Comments: None

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5.0 TEST LOG

All tests were performed on an office computer with the following software and hardware specifications:

- Hardware:
  - Dell Latitude E6510 with i5 M520 2.4 GHz CPU
  - 4 GB RAM
  - 232 GB Hard Drive
- Software:
  - Windows 7 Enterprise, Service Pack 1, 64-bit
  - MS .Net Framework 4
  - MS Excel 2007

Table 4: Test Log

Date/Time	Location	Test	Tester
2015-03-27 1034	Columbia, MD	T-01	Lars Ericson
2015-03-27 1039	Columbia, MD	T-02	Lars Ericson
2015-03-27 1041	Columbia, MD	T-03	Lars Ericson
2015-03-27 1044	Columbia, MD	T-04	Lars Ericson
2015-03-27 1046	Columbia, MD	T-05	Lars Ericson
2015-03-27 1052	Columbia, MD	T-06	Lars Ericson
2015-03-27 1056	Columbia, MD	T-07	Lars Ericson
2015-03-27 1059	Columbia, MD	T-08	Lars Ericson
2015-03-27 1103	Columbia, MD	T-09	Lars Ericson
2015-03-27 1105	Columbia, MD	T-10	Lars Ericson
2015-03-27 1118	Columbia, MD	T-11	Lars Ericson
2015-03-27 1122	Columbia, MD	T-12	Lars Ericson
2015-03-27 1139	Columbia, MD	T-13	Lars Ericson
2015-03-27 1333	Columbia, MD	T-14	Lars Ericson
2015-03-27 1338	Columbia, MD	T-15	Lars Ericson

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6.0 NOTES

Table 5: Acronyms and Abbreviations

ACRONYM	DESCRIPTION
ANSI	
ASD(R&E)	Assistant Secretary of Defense for Research and Engineering
AT&L	Acquisition, Technology, and Logistics
CoE	Center of Excellence
CSCI	Computer Software Configuration Item
CSV	Comma-Separated Value
DOD	Department of Defense
DOJ	Department of Justice
EBTS	Electronic Biometrics Specification Transmission
EFS	Extended Feature Set
FBI	Federal Bureau of Investigation
GB	Gigabyte
GUI	Graphical User Interface
LFFS	Latent Friction Ridge Features Search
MASI	ManTech Advanced Systems International
MB	Megabyte
MDT	Minutia Deviation Tool
MS	Microsoft
NIJ	National Institute of Justice
NIST	National Institute of Standards and Technology
NLECTC	National Law Enforcement and Corrections Technology Center
OSD	Office of the Secretary of Defense
RAM	Random Access Memory
SD-27a	NIST Special Database 27a
SDD	Software Design Description
SRS	Software Requirements Specification
SSBT	Sensor, Surveillance, and Biometric Technologies
STD	Software Test Description

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ACRONYM	DESCRIPTION
ULW	Universal Latent Workstation

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