

Subject: RE: DWI to DTI estimation in Slicer
Date: Friday, May 24, 2013 4:24:31 PM Eastern Daylight Time
From: Welch, David M (UI Health Care)
To: Johnson, Hans J

Done. [http://wiki.namicro.org/Wiki/index.php/Investigate_Potential_Tensor_Computation_Improvement_via_Positive_Semi-Definite_\(PSD\)_Tensor_Estimation](http://wiki.namicro.org/Wiki/index.php/Investigate_Potential_Tensor_Computation_Improvement_via_Positive_Semi-Definite_(PSD)_Tensor_Estimation)

David Welch, M.S.
Applications Developer

Department of Psychiatry
University of Iowa
(319)384-9413
dmwelch@healthcare.iowa.edu
david-welch@iowa.edu

From: Johnson, Hans J
Sent: Thursday, May 23, 2013 7:37 PM
To: Welch, David M (UI Health Care)
Subject: FW: DWI to DTI estimation in Slicer

Dave,

Make this into a project week project to investigate this potential tensor computation improvement. Assign it to me please.

Hans

From: Raul San Jose <rjosest@bwh.harvard.edu>
Date: Saturday, February 9, 2013 9:32 PM
To: Hans Johnson <hans-johnson@uiowa.edu>
Cc: Marc Niethammer <mn@cs.unc.edu>, Carl-Fredrik Westin <westin@bwh.harvard.edu>, Demian Wassermann <demian@bwh.harvard.edu>, Joy Matsui <joy-matsui@uiowa.edu>, Marc Niethammer <mn@email.unc.edu>
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Subject: Re: DWI to DTI estimation in Slicer

Date: Sunday, February 10, 2013 10:34:59 PM Eastern Standard Time

From: Raul San Jose

To: Johnson, Hans J

CC: Marc Niethammer, Carl-Fredrik Westin, Demian Wassermann, Matsui, Joy T, Marc Niethammer

Hi Hans,

The main problem that I see with this approach is that the fix does not happen during the estimation. If you are targeting a LS-PSD tensor estimation, you have to refactor some of the code from `vtkDiffusionTensorMathematics` into `vtkTeemEstimateDiffusionTensor`. There, you can compute the normal tensor estimation and then reassemble the tensor with the PSD correction.

Does it make sense?

/R

On Feb 9, 2013, at 9:50 PM, "Johnson, Hans J" <hans-johnson@uiowa.edu> wrote:

Thank you.

What I am planning to do is to add a new "Estimation Parameters" radio button called "o LS-PSD"

<60A2A340-A85D-4B9D-A2E7-DE5477D325BD.png>

If LS-PSD is selected, then everything that happens for "LS" will continue to happen, but also

```

-//      if (vtkDiffusionTensorMathematics::FixNegativeEigenvaluesMethod(w)) {
-//          vtkGenericWarningMacro( "Warning: Eigenvalues are not properly sorted"
-//      );
-//      }
=====
+      if ( LS-PSD selected )
+      {
+          if (vtkDiffusionTensorMathematics::FixNegativeEigenvaluesMethod(w)) {
+              vtkGenericWarningMacro( "Warning: Eigenvalues are not properly sorted" )
+          ;
+          }
+      }

```

Does that seem like the correct approach?

*Thanks,
Hans*

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To: Raul San Jose <rjosest@bwh.harvard.edu>

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Subject: Re: DWI to DTI estimation in Slicer
Date: Sunday, February 10, 2013 6:53:34 AM Eastern Standard Time
From: Johnson, Hans J
To: Matsui, Joy T
Category: Personal, Business

The beauty of NAMIC is that you can fix it for everyone else. If you do not have a password, you can get one, you can ask dave to post it, or you can ask demean to post it.

Hans

From: <Matsui>, Joy Matsui <joy-matsui@uiowa.edu>
Date: Saturday, February 9, 2013 10:20 PM
To: Hans Johnson <hans-johnson@uiowa.edu>
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To: Johnson, Hans J

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Date: Friday, January 25, 2013 9:05 AM
To: Marc Niethammer <mn@cs.unc.edu>
Cc: Carl-Fredrik Westin <westin@bwh.harvard.edu>, Hans Johnson <hans-johnson@uiowa.edu>, Demian Wassermann <demian@bwh.harvard.edu>, Joy Matsui <joy-matsui@uiowa.edu>, Marc Niethammer <mn@email.unc.edu>
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Subject: Re: DWI to DTI estimation in Slicer
Date: Saturday, February 9, 2013 8:50:04 PM Eastern Standard Time
From: Johnson, Hans J
To: Marc Niethammer, Raul San Jose
CC: Carl-Fredrik Westin, Demian Wassermann, Matsui, Joy T, Marc Niethammer
Category: Personal, Business

Thank you.

What I am planning to do is to add a new "Estimation Parameters" radio button called "o LS-PSD"

▼ Estimation Parameters

Estimation Parameters LS WLS

If LS-PSD is selected, then everything that happens for "LS" will continue to happen, but also

```
-//      if (vtkDiffusionTensorMathematics::FixNegativeEigenvaluesMethod(w)) {
-//          vtkGenericWarningMacro( "Warning: Eigenvalues are not properly sorted" );
-//      }
=====
+      if ( LS-PSD selected )
+      {
+          if (vtkDiffusionTensorMathematics::FixNegativeEigenvaluesMethod(w)) {
+              vtkGenericWarningMacro( "Warning: Eigenvalues are not properly sorted" );
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Does that seem like the correct approach?

*Thanks,
Hans*

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Subject: Re: DWI to DTI estimation in Slicer

Date: Saturday, February 9, 2013 8:38:49 PM Eastern Standard Time

From: Marc Niethammer

To: Raul San Jose

CC: Johnson, Hans J, Carl-Fredrik Westin, Demian Wassermann, Matsui, Joy T, Marc Niethammer

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Date: Saturday, February 9, 2013 2:32:04 PM Eastern Standard Time

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To: Johnson, Hans J

CC: Marc Niethammer, Carl-Fredrik Westin, Demian Wassermann, Matsui, Joy T, Marc Niethammer

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To: Raul San Jose, Marc Niethammer
CC: Carl-Fredrik Westin, Demian Wassermann, Matsui, Joy T, Marc Niethammer
Category: Personal, Business

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Cc: Carl-Fredrik Westin <westin@bwh.harvard.edu>, Hans Johnson <hans-johnson@uiowa.edu>, Demian Wassermann <demian@bwh.harvard.edu>, Joy Matsui <joy-matsui@uiowa.edu>, Marc Niethammer <mn@email.unc.edu>
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Hi Hans,

Just to add my two cents. In Slicer 2 we were taking the absolute value of Indefinite tensors. Odd but it worked. When we shift to the Teem as our estimation engine this situation was handled by teem. My recollection is that teem rounds to zero but I should check that. I can get back to you in a bit with more info.

/R

Sent from my iPhone

On Jan 25, 2013, at 8:57 AM, Marc Niethammer <mn@cs.unc.edu> wrote:

Hi Hans, hi CF,

I vaguely remember that Raul hacked something into Slicer code at some point, but this was a long time ago and mainly for testing. I did most of my tests in matlab.

It is indeed a little counter-intuitive, but it is what comes out of the math. This kind of correction actually appears to hold for an arbitrary number of gradient directions as long as they have isocahedral symmetry. (I can send you a pretty long tech report on this that we unfortunately never published :-(-- the paper you are referring to only talks about 6 directions, but it actually generalizes).

I hope this helps.

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best

C-F

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Director, Laboratory of Mathematics in Imaging (LMI)

Associate Professor of Radiology, Harvard Medical School

<http://lmi.bwh.harvard.edu/~westin>

On Jan 25, 2013, at 1:29 AM, "Johnson, Hans J" <hans-johnson@uiowa.edu> wrote:

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> Is the algorithm defined in:

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Marc Niethammer
Assistant Professor

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[University of North Carolina at Chapel Hill](#)

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Chapel Hill, NC 27599-3175
Office: 219 Sitterson Hall
919.843.7449 (phone)
919.962.1799 (fax)

<http://wwwx.cs.unc.edu/~mn/>

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Subject: Re: DWI to DTI estimation in Slicer

Date: Friday, January 25, 2013 8:05:26 AM Eastern Standard Time

From: Raul San Jose

To: Marc Niethammer

CC: Carl-Fredrik Westin, Johnson, Hans J, Demian Wassermann, Matsui, Joy T, Marc Niethammer

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Subject: Re: DWI to DTI estimation in Slicer

Date: Friday, January 25, 2013 7:57:40 AM Eastern Standard Time

From: Marc Niethammer

To: Carl-Fredrik Westin

CC: Johnson, Hans J, Demian Wassermann, Matsui, Joy T, Marc Niethammer, Raul San Jose

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Subject: Re: DWI to DTI estimation in Slicer
Date: Friday, January 25, 2013 3:13:08 AM Eastern Standard Time
From: Carl-Fredrik Westin
To: Johnson, Hans J
CC: Demian Wassermann, Matsui, Joy T, Marc Niethammer

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Subject: Re: DWI to DTI estimation in Slicer
Date: Thursday, January 24, 2013 7:13:00 PM Eastern Standard Time
From: Matsui, Joy T
To: Johnson, Hans J

Hans,

I am using Slicer to create the tensor images. I can't tell what is implemented in Slicer just by looking at the source.

This is what I was talking to you about earlier. Negative eigenvalues or non-symmetric positive definite tensors are the result of noise in the DWI. If your image has a lot of non-SPD tensors (especially in important tissues), then you shouldn't use it because it's too noisy. If they're going to show up in a good tensor image, then they're going to show up on the edges of the tensor image (along the skull). So they shouldn't be that big a deal.

DTITK has a tool that detects non-SPD voxels and can create a binary mask corresponding to the non-SPD voxels in an image, along with an image that supposedly only has SPD voxels. However, it seems that the original symm log demons tensor registration tool picks up tensors that have negative eigenvalues that the DTITK tool doesn't pick up and stops running. However, Kent added in the same negative eigenvalue removing code used in DTITK into the symm log demons tensor registration tool to get it to run (and it doesn't do a bad job....surprisingly).

Joy

From: <Johnson>, Hans J <hans-johnson@uiowa.edu>
Date: Thursday, January 24, 2013 6:29 PM
To: Demian Wassermann <demian@bwh.harvard.edu>, Carl-Fredrik Westin <westin@bwh.harvard.edu>
Cc: Joy Matsui <joy-matsui@uiowa.edu>
Subject: DWI to DTI estimation in Slicer

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Help Acknowledgement

This command module is based on the estimation functionality provided by the Teem library. This work is part of the National A for Medical Image Computing (NAMIC), funded by the National Institutes of Health through the NIH Roadmap for Medical Res Grant U54 EB005149.


Contributors: *Raul San Jose (SPL and BWH)*

▼ DWI to DTI Estimation

Parameter set: DWI to DTI Estimation

Status

▼

▼ 

Input DWI Volume	Select a DiffusionWeightedVolume
Diffusion Tensor Mask	None
Output DTI Volume	Select a DiffusionTensorVolume
Output Baseline Volume	Select a Volume

▼ Estimation Parameters

Estimation Parameters LS WLS

Shift Negative Eigenvalues

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Subject: DWI to DTI estimation in Slicer
Date: Thursday, January 24, 2013 6:29:11 PM Eastern Standard Time
From: Johnson, Hans J
To: Demian Wassermann, Carl-Fredrik Westin
CC: Matsui, Joy T
Category: Personal, Business

Demian or CF,

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<u>Contributors:</u> <i>Raul San Jose (SPL and BWH)</i>	
▼ DWI to DTI Estimation	
Parameter set: <input type="text" value="DWI to DTI Estimation"/>	
Status	
▼ IO	
Input DWI Volume	<input type="text" value="Select a DiffusionWeightedVolume"/>
Diffusion Tensor Mask	<input type="text" value="None"/>
Output DTI Volume	<input type="text" value="Select a DiffusionTensorVolume"/>
Output Baseline Volume	<input type="text" value="Select a Volume"/>
▼ Estimation Parameters	
Estimation Parameters	<input checked="" type="radio"/> LS <input type="radio"/> WLS
Shift Negative Eigenvalues	<input checked="" type="checkbox"/>

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Thanks for you help.

Hans