Dynamic Light Scattering-Optical Coherence Tomography (DLSOCT) Data Processing Guide

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Introduction:

This guide is for post data processing of DLSOCT which outputs axial velocity (Vz), transverse velocity (Vx), total velocity(V), ratio of static component (Ms), ratio of dynamic component (Mf), and fitting accuracy (R). The speed upper limit is determined by OCT system Aline rate and 3D-voxel size.

Please cite the following references[1,2]:

1. Tang, J. *et al.* Shear-induced diffusion of red blood cells measured with dynamic light scattering-optical coherence tomography. *J. Biophotonics* **11**, e201700070 (2018).

2. Lee, J., Wu, W., Jiang, J. Y., Zhu, B. & Boas, D. A. Dynamic light scattering optical coherence tomography. *Opt. Express* **20**, 22262 (2012).

I. Data acquisition

OCT-based M-mode data acquisition, i.e. repeat Ascan at each X-Y scanning location for a certain period. The data should be saved sequentially as a 1D array (ASCII int16) and named as: RAW-nk-nxRpt-nx-nyRpt-ny-iC, e.g. RAW-1024-100-00400-001-400-1.dat.

II. Input

```
% 1D array spectrum, nK*nXrpt*nX*nY, data format: ASCII int16
        % nK: spectrum pixel (camera elements); nXrpt: Ascan repeat;
        % nX: number of Ascans per Bscan; nY: number of Bscans for the whole volum
        % NOTE: the raw data for the whole volume is usually very large, it's 
recommended to process chunk by chunk
    % PRSinfo: processing information
    % PRSinfo.FWHM: Full width at Half Maxim, Amplitude, [transverse, axial], m
    % PRSinfo.fAline: DAQ Aline rate, Hz
    % PRSinfo.Lam: [light source center, wavelength bandwidth], m
    % PRSinfo.Dim: [nz,nx,nyPchk,nTau]
    % PRSinfo.g1_Start: start time for g1 calculation
    % PRSinfo.g1_nt: number of time points for g1 calculation
    % PRSinfo.g1_ntau: number of g1 time lag
    % PRSinfo.intDk: OCT lambda to k space interpolation factor (calibration is 
required)
```

Example data:

https://drive.google.com/open?id=168HD4lKt0K97g09zus6H9h7lAyO0jOBZ
https://drive.google.com/open?id=1QvTO_41cPN3_wM9wxCh9NECv_hypVZPC

III. Output

```
     % Vt, mm/s, [nz,nx,ny]
    % Vz, mm/s, [nz,nx,ny]
    % D, um^2/s, [nz,nx,ny]
    % Ms, Mf, R, [nz,nx,ny]
```

I. CPU calculation-based sub-functions

```
% function [Dim, fNameBase, fIndex]=GetNameInfoRaw(filename0)
% function DAT= ReadDat_int16(filePath, Dim, iseg, ARpt_extract,RptBscan)
% function RR = DAT2RR(Dat, intpDk)
% function GG = RR2g1(RR, PRSinfo)
% function [Ms, Mf, Vt, Vz, D, R, GGf]=GG2VDR(GG, PRSinfo)
    % function RotCtr = FindCOR(GG)
    % function [Vz]=GG2Vz(GG, PRSinfo, nItp)
        % function ACF = aCorr(DAT, dim)
    % function [Vt,Vz,D,R]=iniDLSOCT(GG, Vz0, Ms0, Mf0, PRSinfo)
```

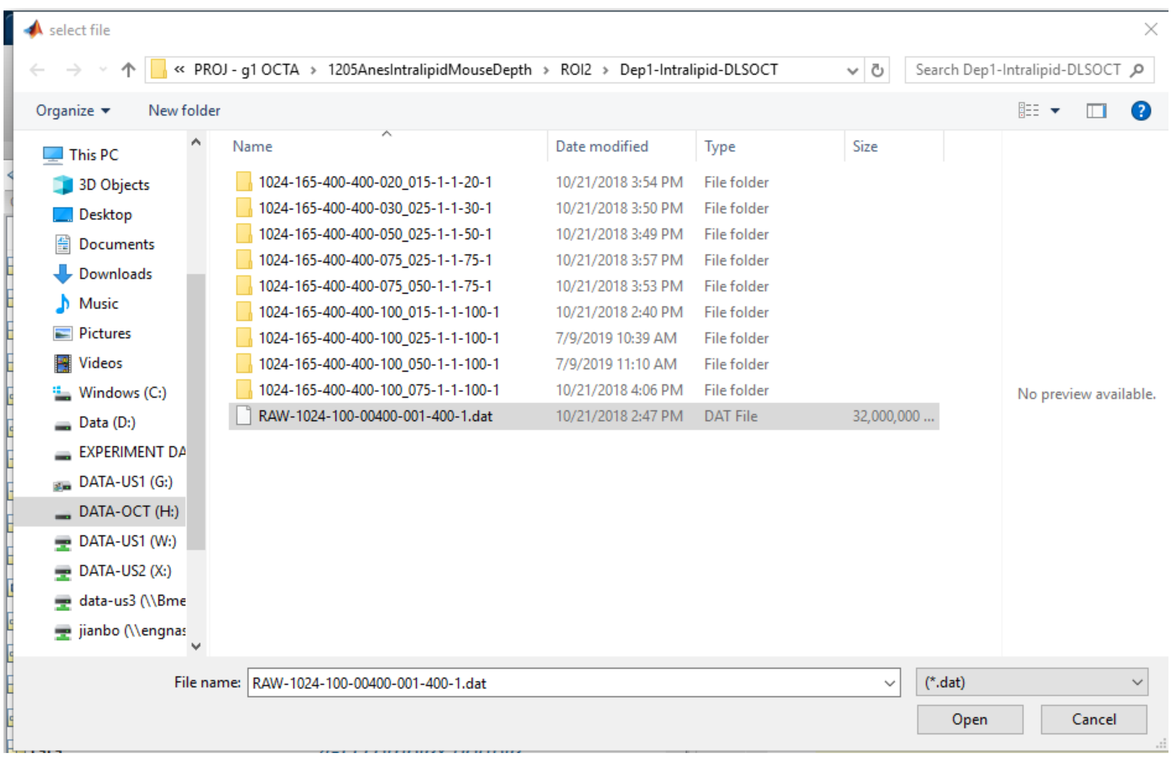
II. GPU calculation-based sub-functions

Note: the minimal GPU memory requirement is 16 GB.

```
% function [Dim, fNameBase, fIndex]=GetNameInfoRaw(filename0)
% function DAT= ReadDat_int16(filePath, Dim, iseg, ARpt_extract,RptBscan)
% function RR = DAT2RR_GPU(Dat, intpDk)
% function GG = RR2g1_GPU(RR, PRSinfo)
% function [Ms, Mf, Vt, Vz, D, R, GGf]=GG2VDR_GPU(GG, PRSinfo)
    % function RotCtr = FindCOR(GG)
    % function [Vz]=GG2Vz_GPU(GG, PRSinfo, nItp)
        % function ACF = aCorr(DAT, dim)
    % function [Vt,Vz,D,R]=iniDLSOCT_GPU(GG, Vz0, Ms0, Mf0, PRSinfo)
```

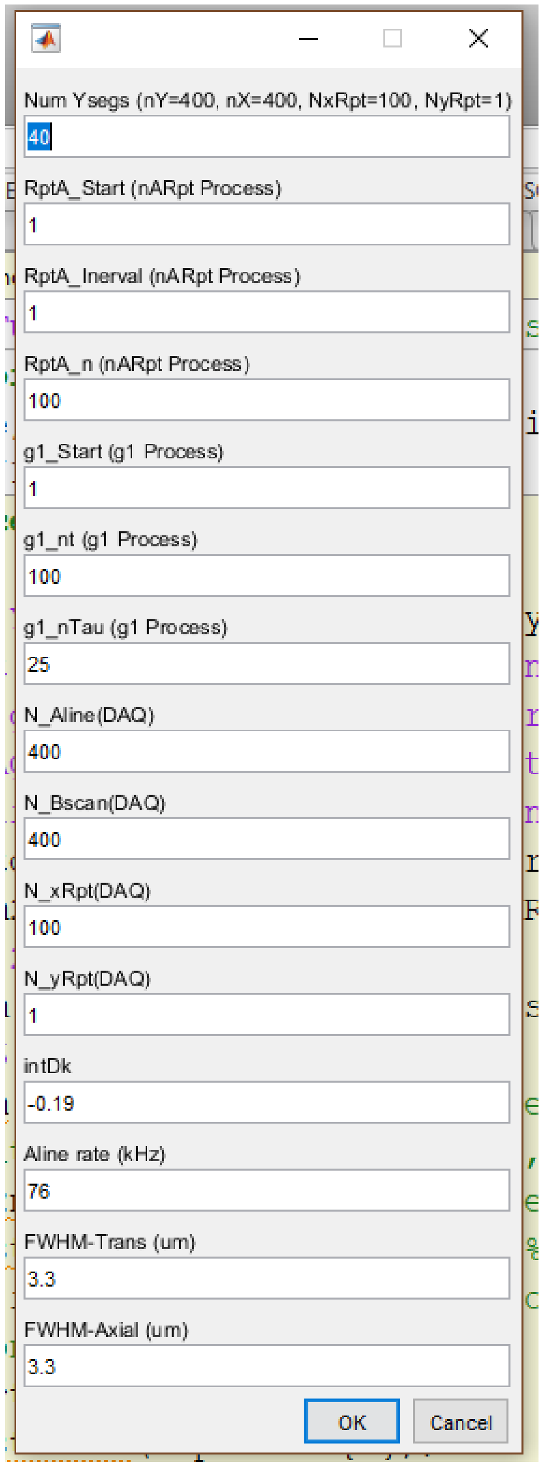
III. Main_DLSOCT data processing

III.1 select file

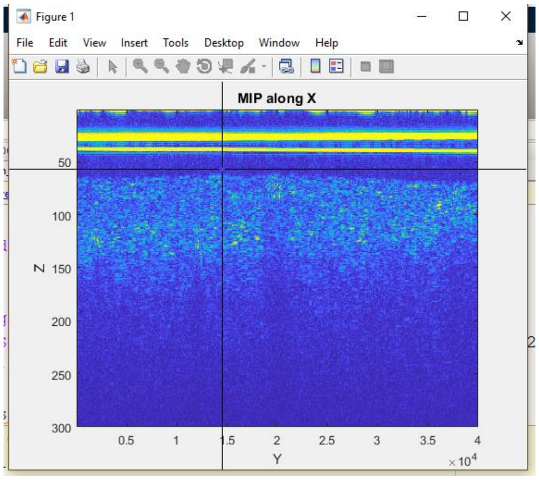


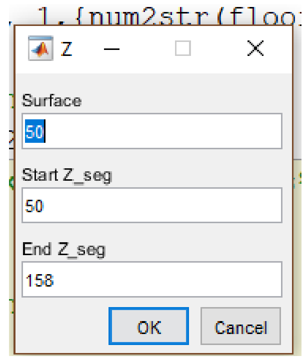
III.2 data processing parameter

Specify the number of chunks for data processing (split large data size into small chunks), and the g1 calculation parameters (nTau and nt). Double check the intDk, Aline rate, and FWHM (OCT system transverse and axial resolution).

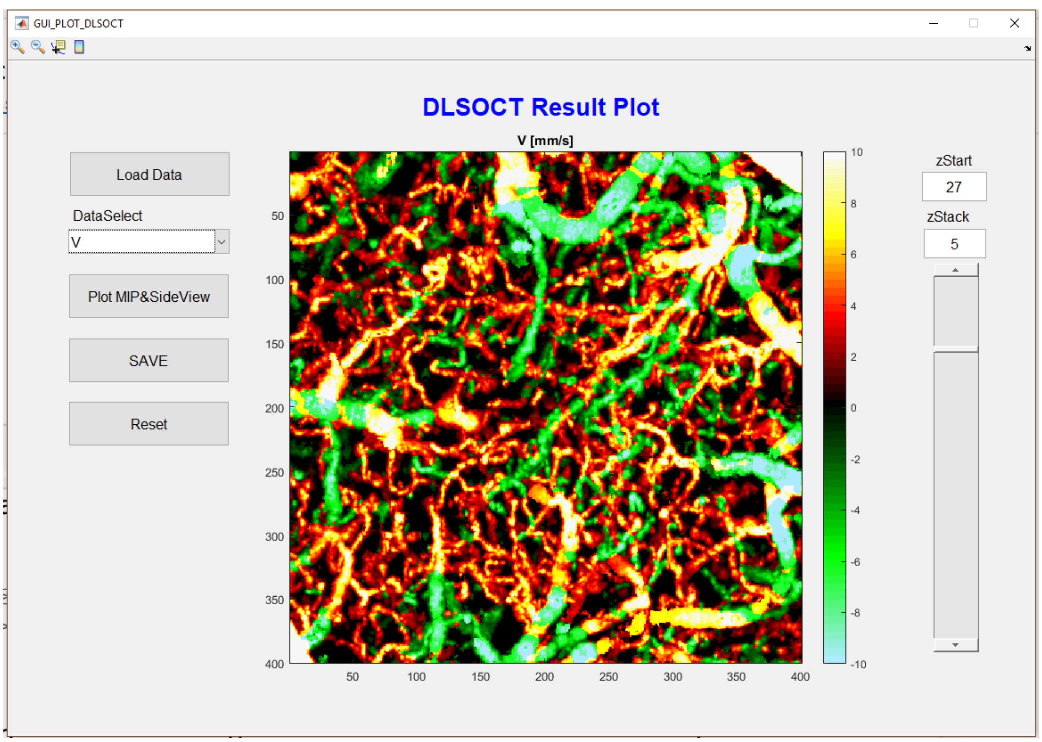


III.3 select the axial data processing range [surface, zStart, zEnd]

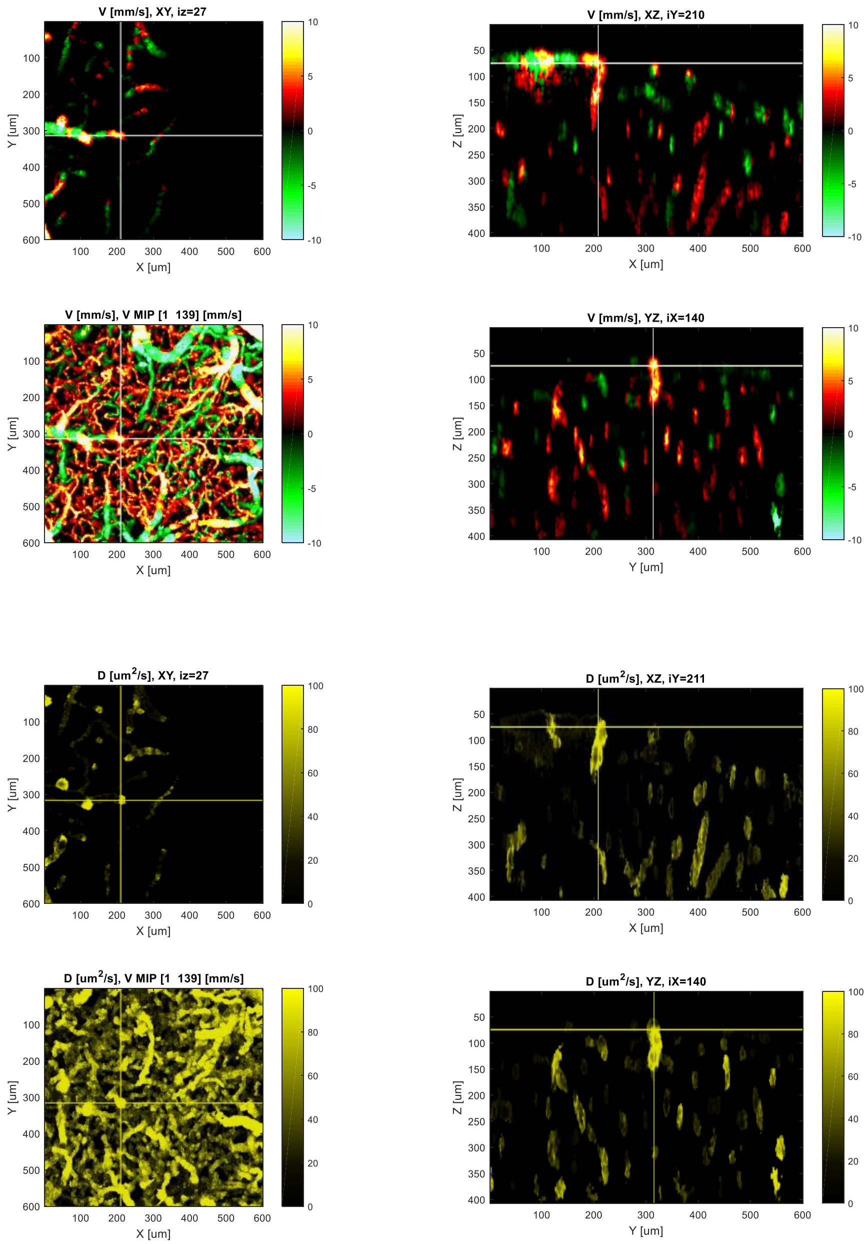




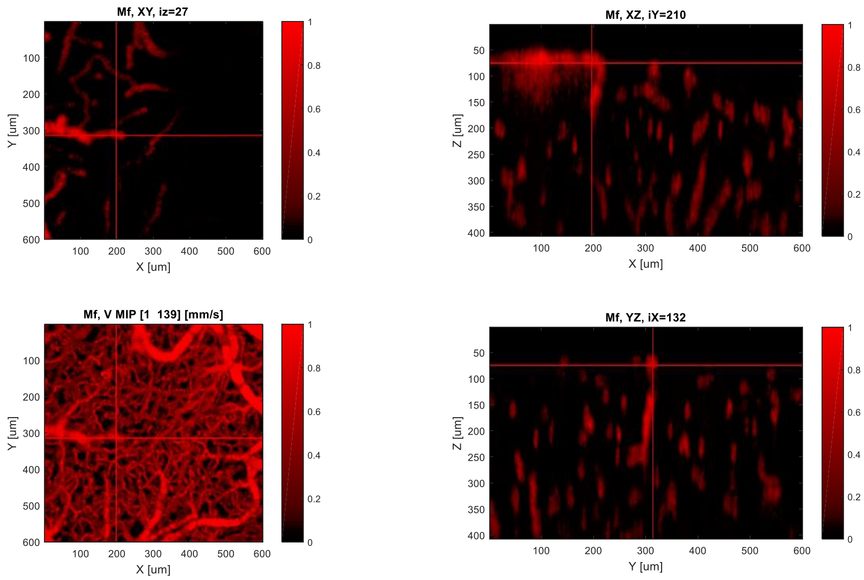
III.3 DLSOCT result plot (GUI_PLOT_DLSOCT)



1. Load the saved DLSOCT data
2. Select which data to plot (DataSelect)
3. Use the slider or zStart+zStack to check single or MIP (maxim intensity projection) en face plane.
4. Use ‘Plot MIP&SideView’ to plot a MIP for certain depth range (set SideView(N:0; Y:1) to 0). Or plot XY, YZ, XZ, and MIP figures by set SideView(N:0; Y:1) to 1.



V [mm/s], XY, iz=27
V [mm/s], XZ, iY=210
V [mm/s], V MIP [1 139] [mm/s]
V [mm/s], YZ, iX=140
D [um2/s], XY, iz=27
D [um2/s], XZ, iY=211
D [um2/s], V MIP [1 139] [mm/s]
D [um2/s], YZ, iX=140
X [um]
Y [um]
Z [um]
10
5
0
-5
-10
100
80
60
40
20
0


Mf, XY, iz=27
Y [um]
X [um]
Mf, XZ, iY=210
Z [um]
X [um]
Mf, V MIP [1 139] [mm/s]
Y [um]
X [um]
Mf, YZ, iX=132
Z [um]
Y [um]