**User's Guide for the Spectral Angle Version of HySPADE**

Thanks for your interest in HySPADE! It is engineering code without a graphical user interface (GUI). It doesn't have much of a DOS command prompt window presence, either. Nonetheless, it is a fully functioning, quite stable C code program.

Below is part of the first page of the C code. Several items are highlighted in **bold red** text. These items need to be customized/changed for each application of HySPADE to an imaging spectrometer data cube. Use a text editor to edit the C code program.

But before we discuss these items, the HSI data cube that is to be given to HySPADE **must** be band interleaved by line (BIL) and floating point values. Modify your data cube to have these parameters.

Now, onto the items in **bold red** text, below.

**1)** Enter the cube's parameters as indicated: number of lines, samples, bands, and header size (in bytes).

**2)** Customize the window size. Shown are the parameters for a 50 x 50-pixel window. 'RXC' **must** be ROW x COL in size.

**3)** WINDOW\_ROW\_STEP and WINDOW\_COL\_STEP **must** both be ROW-2 and COL-2, respectively, in size.

**4)** EP is set for 20; this will generate 20 HySPADE output planes with 20 different threshold levels. In other words, HySPADE generates an image cube with band sequential interleaving. The number of samples and lines is equal to those of the original HSI cube analyzed. Data type is unsigned integer.

**5)** EPDIV is set to 5. This will generate thresholds with values that are 1/5, 2/5, 3/5, ..., 20/5. This is the setting used to generate the results shown in the 2012 SPIE paper and briefing. I.e., the threshold values associated with each of the 20 output HySPADE planes start at 0.4, go to 4.0 in increments of 0.2.

**6)** Save changes; make sure the file is still a text file. Compile. I've used Microsoft Visual C++ 2010 Express Edition on a personal computer workstation running Microsoft Windows 7 for the results shown in the SPIE paper and briefing. I suggest the following steps. Launch the 'Visual Studio Command Prompt' DOS command prompt window. Change directory to the directory containing the C code HySPADE program and the data cube. Compile HySPADE.

**7)** Run the resulting executable. HySPADE has only two prompts: the name of the input file (with path) and the name of the output file (also with path). Once again, the data cube that is to be given to HySPADE must be band interleaved by line (BIL) and floating point values.

**8)** Open the result in ENVI®. HySPADE generates an image cube with band sequential (BSQ) interleaving. The number of samples and lines is equal to those of the original HSI cube analyzed. Data type is unsigned integer. If you've used EP = 20 and EPDIV = 5, then the generic .hdr file given elsewhere on this web site (filename 'Generic\_Header\_File.hdr') may be accessed to build the specific .hdr file for your HySPADE result. You'll have to edit the appropriate number of samples and lines; these values will be equal to those of the original input cube given to HySPADE. Number of bands will be 20 as long as EP = 20 and EPDIV = 5.

**9)** If you have questions, please send via e-mail to: rresmini@gmu.edu.

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/\* Program samedge1.c \*/

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/\* This program accepts as input a float BIL HSI image cube. It then

 calculates a new image cube composed of the magnitude of the

 spectral angle of each original image cube vector (spectrum)

 wrt every other pixel in the cube. In other words, the first

 "band" of the output cube is composed of the spectral angle

 of each original image cube spectrum wrt the pixel at

 (1,1). The 2nd "band" contains spectral angle of each image

 spectrum wrt the pixel at (1,2), &etc.

 This verison employs calloc-generated dynamic menory allocation.

 Most current version as of 30 May 2011; supercedes HySPADE.cpp.

 Program written by: Ronald G. Resmini, Ph.D.

 May 30, 2011

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/\* Modification History: \*/

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#include <stdio.h>

#include <string.h>

#include <stdlib.h>

#include <malloc.h>

#include <math.h>

**// Dimensions for the input HSI data cube:**

#define ROWFULL **600** // Lines

#define COLFULL **320** // Samples

#define BANDS **30** // Bands

#define HEADER **0** // Header

**// Dimensions for window**

#define ROW **50**

#define COL **50**

#define RXC **2500**

#define WINDOW\_ROW\_STEP **48**

#define WINDOW\_COL\_STEP **48**

#define EP **20**

#define EPDIV **5**