

Optimum Index Factor

The optimum index factor (OIF) is a method for determining the three-band combination that maximizes the variability in a particular scene and was developed by Chavez et al (1982; 1984). The optimum three-band combination is useful for visualization purposes, but may also be useful in analysis. An OIF is calculated for each of the 20 possible three-band combinations that can be created from the six bands of Landsat TM data (excluding the thermal band). Although the OIF method was developed for Landsat TM data, it is applicable to any multispectral remote sensing dataset. Kienast-Brown and Boettinger (2010) found utility in applying OIF to multiple data types; terrain derivatives, as well as remote sensing data.

OIF is based on the amount of total variance and correlation within and between the possible band combinations. The three-band combinations are ranked, and those with the largest OIF values contain the most information (measured by variance) with the least amount of duplication (measured by correlation) and are the best choices for maximizing the variability in a particular scene. For viewing purposes, the analyst must decide what color channel (red, green, or blue) to assign each band of the three-band combination. The following equation is used to calculate OIF for any three-band combination:

$$OIF = \frac{\sum_{k=1}^3 s_k}{\sum_{j=1}^3 Abs(r_j)}$$

where s_k is the standard deviation for band k , and r_j is the absolute value of the correlation coefficient between any two of the three bands being evaluated. Standard deviation values are obtained using the Metadata button in Imagine, and the correlation coefficients for a particular scene are derived using Model Maker in Imagine. An Excel spreadsheet programmed with the equation above is provided and can be used to calculate and rank OIF values.

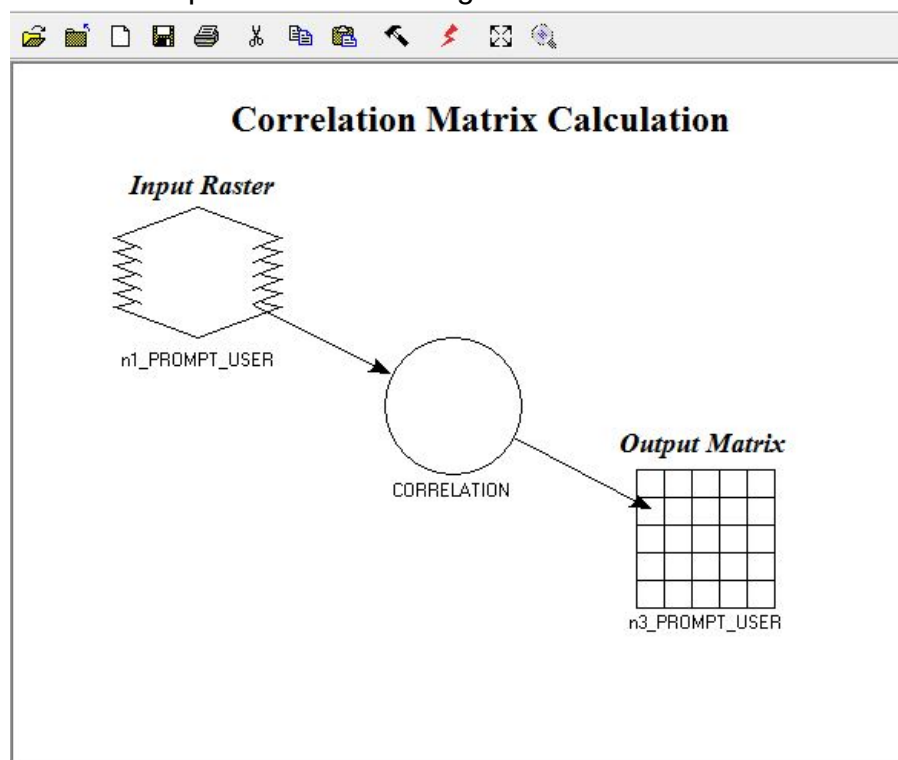
File: OIF_correlationmatrix.gmd (ERDAS Imagine Model Maker model, v. 2014 and prior)** OR
OIF_correlation_matrix_modeler.gmdx (ERDAS Imagine Spatial Modeler model, v. 2013 and later)**
and OIF_worksheet.xlsx

Input: 6-band Landsat image (or any 6-band image) for correlation matrix model; correlation matrix and standard deviation values for image bands for worksheet

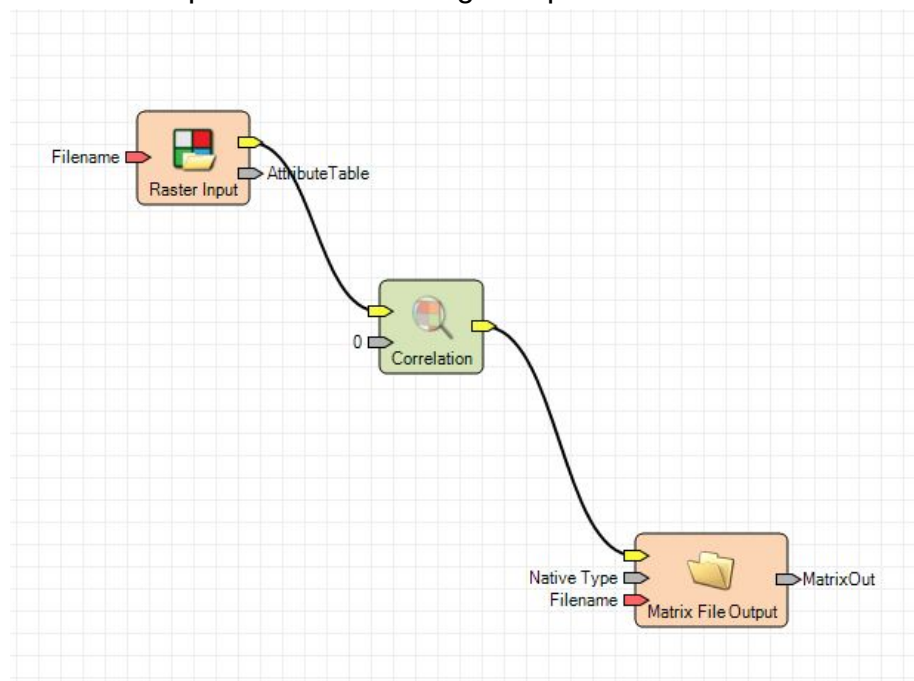
Output: Model outputs the correlation matrix for input image; Worksheet uses correlation matrix and standard deviation values to calculate OIF values for the 20 possible three-band combinations for input image, and rank them largest OIF value to smallest.

You will be prompted for the input image, and to name the output matrix when running the model.

The model open in ERDAS Imagine Model Maker:



The model open in ERDAS Imagine Spatial Modeler:



OIF worksheet for example dataset. The absolute value of the correlation coefficients must be used (see equation above). Standard deviation values for each band of the input image are obtained using the Metadata button in Imagine. After OIF values are calculated, you must sort descending to get the ranked band combinations and associated OIF values:

	A	B	C	D	E	F	G
1	OIF- Worksheet						
2	Example Dataset						
3							
4							
5	Correlation Matrix						
6	TM band	1	2	3	4	5	7
7	1	1.00	0.99	0.99	0.91	0.80	0.83
8	2	0.99	1.00	0.99	0.89	0.74	0.79
9	3	0.99	0.99	1.00	0.93	0.79	0.83
10	4	0.91	0.89	0.93	1.00	0.88	0.89
11	5	0.80	0.74	0.79	0.88	1.00	0.99
12	7	0.83	0.79	0.83	0.89	0.99	1.00
13							
14							
15	Standard Deviation						
16	TM band	1	2	3	4	5	7
17		35.566	35.28	44.152	35.089	50.753	45.168
18							
19							
20				Ranked			
21	Band Combo	OIF		Band Combo	OIF		
22	1,2,3	38.73		3,5,7	53.60		
23	1,2,4	38.00		2,5,7	52.09		
24	1,2,5	48.03		2,3,5	51.46		
25	1,2,7	44.53		1,3,5	50.64		
26	1,3,4	40.67		1,5,7	50.30		
27	1,3,5	50.64		3,4,5	49.86		
28	1,3,7	47.20		2,4,5	48.10		
29	1,4,5	46.93		1,2,5	48.03		
30	1,4,7	44.10		2,3,7	47.76		
31	1,5,7	50.30		4,5,7	47.41		
32	2,3,4	40.73		1,3,7	47.20		
33	2,3,5	51.46		1,4,5	46.93		
34	2,3,7	47.76		3,4,7	46.91		
35	2,4,5	48.10		2,4,7	45.01		
36	2,4,7	45.01		1,2,7	44.53		
37	2,5,7	52.09		1,4,7	44.10		
38	3,4,5	49.86		2,3,4	40.73		
39	3,4,7	46.91		1,3,4	40.67		
40	3,5,7	53.60		1,2,3	38.73		
41	4,5,7	47.41		1,2,4	38.00		
42							
43							

References: Chavez, P. S., G.L. Berlin, and L. B. Sowers. 1982. Statistical method for selecting Landsat MSS ratios. *Journal of Applied Photographic Engineering*. 8(1): 23-30.

Chavez, P.S., S.C. Guptill, and J. A. Bowell. 1984. Image processing techniques for Thematic Mapper data. *Proceedings, ASPRS Technical Papers*. 2: 728-742.

Kienast-Brown, S. and Boettinger, J.L. 2010. Applying the Optimum Index Factor to multiple data types in soil survey. *In* Boettinger, L.L., Howell, D.W., Moore, A.C., Hartemink, A.E., and Kienast-Brown, S. (eds.) *Digital Soil Mapping: Bridging Research, Environmental Application, and Operation*. Progress in Soil Science. Vol. 2. Springer, Heidelberg.

****** ERDAS Imagine Model Maker files (.gmd) can be opened in ERDAS 2014 and all previous versions of Imagine using Model Maker. Starting with ERDAS 2013, the ERDAS Imagine Spatial Modeler is available and requires the .gmdx file type. The results produced by the model should be the same for either model interface. At some version after 2014, the Model Maker and .gmd files will be obsolete.