SurfSeis README20

(for SurfSeis 2.0 released in November 2006)

(www.kgs.ku.edu/software/SurfSeis/index.html)

Please read "Manual20.pdf" stored in "…\Manual" folder to get familiarized with this version.

Demo version will run for 30 days after importing license from the floppy disk with unlimited executions on the sample data sets.

The following is summarized from "Introduction" (Chapter 1) of the manual.

Since the release of SurfSeis version 1.0 in 2000, the surface-wave method in general has gone through a tremendous amount of applications and research at many places, including the Kansas Geological Survey (KGS). In consequence, SurfSeis 2 has new features that take into account those new methodological developments as well as users' demands for enhanced user-friendliness. Although the manual ("Manual20.pdf") has been prepared mainly to explain the new features, such as those related to the passive part of the multichannel analysis of surface waves (MASW) method, it can serve as a stand-alone manual for both active and passive MASW methods for those who have previous experience in seismic data acquisition and data processing in either body- or surface-wave methods. Other information dealing with previous versions of SurfSeis can be found in the previous manual (v 1.5) and README files stored in "…\Manual" and application folders, respectively.

In this manual, the MASW method has been divided into three categories by survey mode: active, passive remote, and passive roadside MASW methods (Figure 1.1). The active method (Park et al., 1999) was introduced in previous versions of SurfSeis. It is the conventional mode of survey using an active seismic source (e.g., a sledge hammer) and a linear receiver array, collecting data in a roll-along mode. The other two methods utilize surface waves generated passively from ambient cultural (and natural) activities such as traffic (and thunder, tidal motion, atmospheric pressure change, etc.). The passive remote method (Park et al., 2004; 2005) employs a two-dimensional (2-D) receiver array such as a cross or circular layout to record passive surface waves. This results in the most accurate evaluation of shear-wave velocity (Vs) at the expense of more intensive field operation and the burden of securing an wide-open space for the array. This can be a good choice if a relatively regional one-dimensional (1-D) Vs profiling is needed. The passive roadside MASW method (Park and Miller, 2006) adopts the conventional linear receiver array and tries mainly to utilize those surface waves generated from local traffic. It tries to overcome limitations with the passive remote method such as difficulty in securing a spacious area and inconvenience in field operations by sacrificing the accuracy (usually less than 10%) of the Vs evaluation. With this method, the array can be set along the sidewalk or the shoulder of a road and the survey can continue in a roll-along mode for the purpose of 2-D Vs profiling. Using a land streamer for the array can improve the survey speed by as much as a few orders of magnitude. In addition, an active impact (e.g., by using a sledge hammer) can be applied at one end of the array to trigger the long (e.g., 30 sec) recording of data. This can result in the active-passive combined analysis of surface waves for the purpose of obtaining both shallow (e.g., 1-20 m) and deep (e.g., 20-100 m) Vs information simultaneously. A more detailed description of each method can be found in previously cited references. However, field procedures for these methods (both passive and active) have been summarized in this version of manual. Data-processing steps are explained by using the sample data sets stored in the "…\SurfSeis20\SampleData\" folder. All acquisition parameters for the sample data sets are listed in Table 1.1.

A summary of the entire procedure with a MASW method (active or passive) is displayed in the flowchart in Figure 1.2. Major changes and new features with this version are summarized as follows:

1. Modules to process passive surface waves have been added in addition to the previously existing active module (Figure 1.1). Two different types of passive surveys are available: one, called the passive remote MASW method, uses a two-dimensional (2-D) receiver array and the other, called the passive roadside MASW method, uses the conventional 1-D linear array.
2. The way dispersion analysis is executed has been changed so that the previous sequence of 'Preprocess → Overtone → Run → Save' has been divided into two separate steps: (1) generation of dispersion image (called overtone, OT) data and (2) mouse-aided extraction of the dispersion curve from the image. The previous sequence, however, can still be accessed by right-clicking (instead of normal clicking) the 'Dispersion' button in the analysis menu when importing an input seismic file.
3. A new mode of inversion has been added. This is a general Monte-Carlo method applied directly to the dispersion image (instead of the dispersion curve) seeking the best-matching solution through a random search. With this mode, up to four modes of dispersion can be accounted for and all the parameters in a five-layer earth model can be manually changed, if desired, to compare theoretical curve(s) with dispersion trend(s) in the background image.

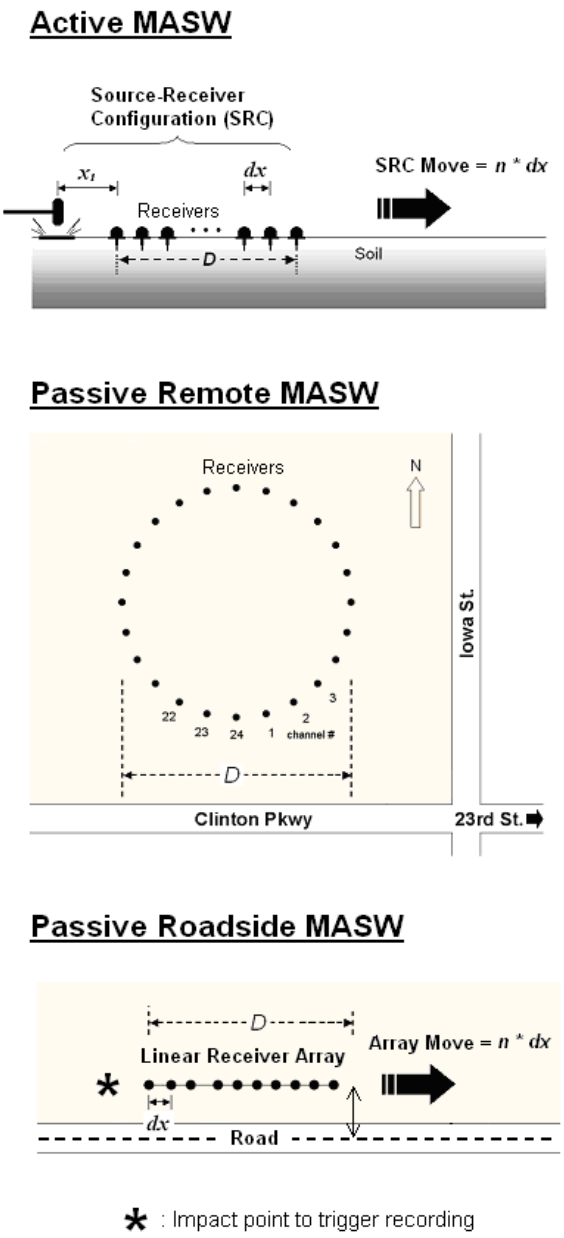
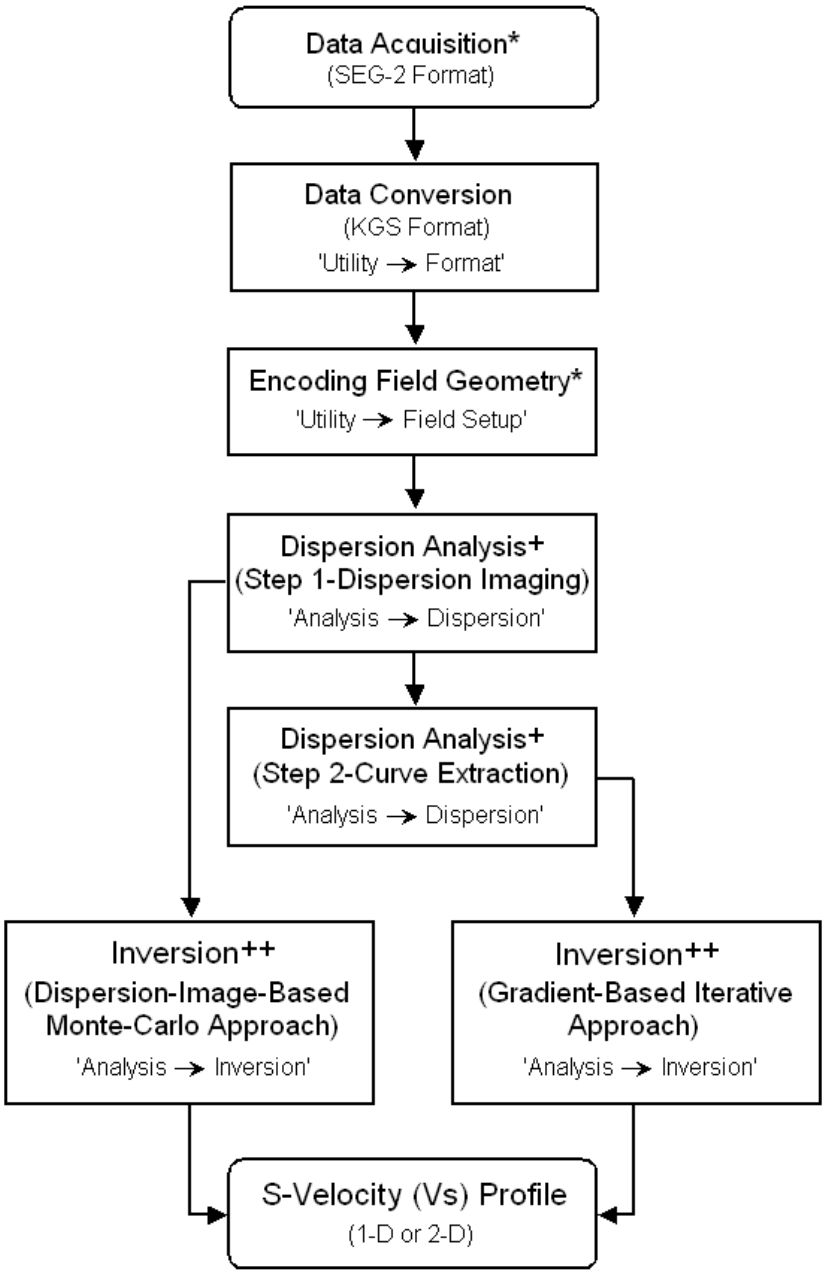


Figure 1.1

Most (if not all) of the bugs existing in previous versions of SurfSeis have been fixed, thanks to the comments and reports from many practitioners who used SurfSeis to conduct the MASW method and who were very patient and always willing to help this quite new geophysical method still in its infancy evolve into a better form. We researchers at KGS sincerely appreciate your patience and assistance.



* See Chapter 2 for active, Chapter 3 for passive remote, and Chapter 4 for passive roadside MASW methods
\+ See Chapter 5
++ See Chapter 6

Figure 1.2

Table 1.1 Summary of Sample Data Parameters

Survey Type	**Active MASW**	**Passive Remote MASW**	**Passive Remote MASW**	**Passive Roadside MASW**
File Name(s)	"1000.dat" — "1009.dat"	"Passive-Cross.dat"	"Passive-Circular.dat"	"4000.dat" — "4009.dat"
Folder	"…\Active\"	"…\PassiveRemote\"	"…\PassiveRemote\"	"…\PassiveRoadside\"
Survey Purpose	2-D Vs Profiling	1-D Vs Profiling	1-D Vs Profiling	2-D Vs Profiling
Data Format	SEG-2	KGS	KGS	SEG-2
Acquisition	24 channel	48 channel	24 channel	48 channel
Source	12-lb Hammer	Traffic	Traffic	12-lb Hammer/Traffic
Receivers (Geophones)	4.5-Hz (spike coupling)	4.5-Hz (spike coupling)	4.5-Hz (spike coupling)	4.5-Hz (land streamer with 30 takeouts)
Receiver Array	Linear (roll along)	Cross (x-y)	Circular	Linear (roll along)
Array Dimension (D)	23 m	115 m	115 m	35 m
Receiver Spacing (*dx*)	1 m	5 m	15 m	1.2 m
Source Offset (x_1)	5 m	N/A	N/A	4.8 m
Receiver Array Move	5 *dx* (5 m)	0	0	4 *dx* (4.8 m)
Sampling Interval (*dt*)	0.25 ms	4 ms	4 ms	4 ms
Recording Time (*T*)	1 sec	20 sec	120 sec	120 sec
Record Numbers	1000 — 1009	2000 — 2009	3000 — 3009	4000 — 4009

References

Park, C. B., and Miller, R. D., 2006, Roadside passive MASW: Proceedings of the SAGEEP, April 2-6, 2006, Seattle, Washington.

Park, C. B., Miller, R. D., Ryden, N., Xia, J., and Ivanov, J., 2005, Combined use of active and passive surface waves: Journal of Engineering and Environmental Geophysics (JEEG), **10**, (3), 323-334.

Park, C. B., Miller, R. D., Xia, J., and Ivanov, J., 2004, Imaging dispersion curves of passive surface waves: SEG Expanded Abstracts: Soc. Explor. Geophys., (NSG 1.6), Proceedings on CD ROM.

Park, C. B., Miller, R. D., and Xia, J., 1999, Multichannel analysis of surface waves (MASW): Geophysics, **64**, 800-808.