

## ZZZZ102 - To see accelerogram and Summarized

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### oscillator spectrum:

This test concerns:

- 1) reading under various formats of an accelerogram on an external file (`LIRE_FONCTION` [U4.21.08]) and the test of the attributes of the function and maximum value,
- 2) the checking of the computation of the oscillator spectrum by `CALC_FONCTION` [U4.62.04] and of the value of high frequency acceleration (  $> 35.5 \text{ Hz}$  ) according to the value max of the accelerogram,
- 3) the reading of an oscillator spectrum in free format on an external file (`LIRE_FONCTION` [U4.21.08]).

There is no mesh nor of model finite element.

## 1 Problem of reference

Several reading of signals are to be realized:

reading of an accelerogram not centered (maximum and  $>0$  different  $<0$  amplitudes) expressed in  $g$  ( $9.81 m.s^{-2}$ ) and search of the maximum amplitude, computation of the oscillator spectrums for a reduced damping  $\xi=0.01$  (1%) with the computation options:

- pseudonym absolute acceleration and to find high frequency driving acceleration ( $f \geq 100 Hz$ ),
  - relative displacement,
- reading of an accelerogram centered (LBEW: seisme of Long Beach East West) and search of the maximum amplitude, computation of the oscillator spectrum in pseudonym absolute acceleration, reading of an oscillator spectrum in free format.

## 2 Reference solution

### 2.1 Results of reference

Accelerogram not centered

$t=7.935$	$a_{max}=-0.638$		
$f=100$	$\xi=0.01$	pseudonym absolute acceleration	$0.638 \times 9.81 = 6.25878$
		Accelerogram	$0.638 \times 9.81 / (2\pi \times 100)^2 = 1.61607 \cdot 10^{-6}$

Displacement centered

$t=3.1$	$a_{max}=1.$		
$f=100 Hz$	$\xi=0.01$	pseudonym acceleration	absolute 1.

Oscillator spectrum

$f=0.5 Hz$	$\xi=0.01$	pseudonym acceleration	absolute 1.09558
	$\xi=0.05$	pseudonym acceleration	absolute 0.657348
	$\xi=0.1$	pseudonym acceleration	absolute 0.109558

### 2.2 Uncertainty on the analytical

solution Solution.

### 2.3 Bibliographical references

1.J.R. LEVESQUE, L. VIVAN, D. SELIGMANN "seismic Response by spectral method" [R4.05.03].

## 3 Modelization A

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### 3.1 Files read

Accelerogram SEPTEN not centered read on unit 19.  
Accelerogram centered doseism read on unit 20.

### 3.2 Test and computation

for each signal read:

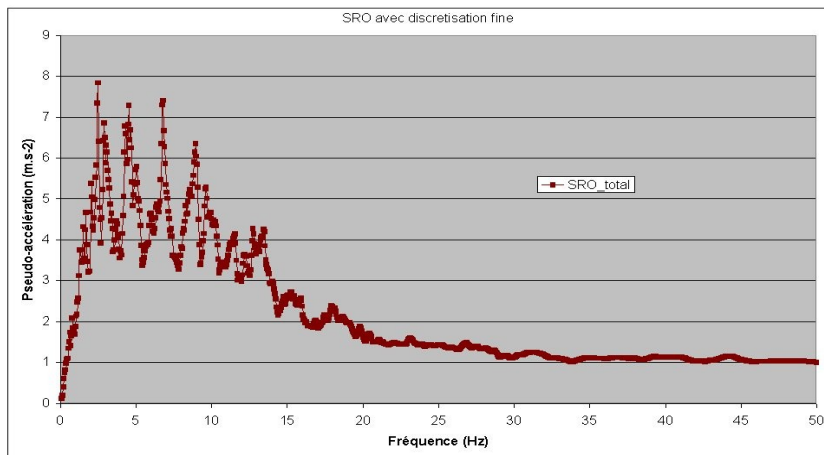
- search of the value max,
- computation of the oscillator spectrum.

```
CALC_FONCTIONMAX
SPEC_OSCINATURE      : "OCCC"
NATURE: "DEPL" or "ACCE"
NORMALIZES: 1. /g or 1.
```

### 3.3 Quantities tested and results

Identification	Reference	% tolerance
amplitude max accelerogram 1 <i>t</i> = 7.935	- 0.638	0.1
oscillator spectrum 1 (not centered) <i>freq.</i> 100 acceleration displacement	6.258778 1.61607288E-06	0.1.0.1
amplitude max accelerogram 2.1.0.0.1 <i>t</i> = 3.1		
oscillator spectrum 2 (centered) <i>freq.</i> 100	1.0.0.1	

### 3.4 Remarks



the accuracy of integration of the oscillator spectrum is not always satisfactory with the frequential list by default (on the asymptotic value, the variation with the reference solution reaches almost 10%). Indeed, this list crosses to  $35,5 Hz$ , whereas the entry signal presents considerable frequential contents until more  $50 Hz$  ... As one can see it on the figure below (spectrum 2):

Generally, one strongly advises with the user always to check as a preliminary the frequential contents (cut-off frequency, sampling) of the signal to treating. Thus, it will be then possible as well as possible to adapt the list of frequencies for the computation of the oscillator spectrum.

This benchmark is precisely the example for which it is necessary to widen the frequential beach, in order to collect the high frequencies of the entry signal well.

In practice, one defines a list of frequencies going from  $0,1 Hz$  to  $100 Hz$  by step of  $0,05 Hz$ , which will be used for the computation of the oscillator spectrum. The variation with the value of reference for the asymptote of pseudo-acceleration becomes lower than 0,02% then.

All these attributes of the functions read or created are tested and exact.

## 4 Modelization B

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### 4.1 File read

Oscillator spectrum

7 frequencies	0.2	0.25	0.3	0.35	0.4	0.45	0.5
5 depreciation	0.01	0.1.0.2.				0.5	
		0.3					

### 4.2 Extraction of the values

For  $FREQ=0.5 Hz$

test of the values associated with the oscillator spectrum for:

$\xi=0.01$  and  $0.1$  (values read)  
 $\xi=0.05$  (values to be interpolated linearly)

### 4.3 extracted Values

$FREQ=0.5 Hz$	Reference	Tolerance
Damping $\xi=0.01$	1.09558	0.
Damping $\xi=0.05$ (interpolated value)	0.657348	0.
$\xi=0.1$	0.109558	0.

### 4.4 Remarks

All the attributes of the three-dimensions function read are good.

## 5 Summary of the results

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the calculation algorithm of the oscillator spectrum does not give a sufficient accuracy with the list of frequencies of integration by default. Indeed the input signal has frequential contents until worms  $50\text{ Hz}$ , whereas the list of frequencies by default for key word SPEC\_OSCI of CALC\_FONCTION stops with  $35,5\text{ Hz}$ .

On this example, it is thus necessary to modify the list of frequencies as starter of the operator. It is thus advisable to be attentive with the spectral contents of the signal and not to trust blindly the values by default (the list by default is appropriate well for the lawful signals that one usually meets in France from which the cut-off frequency is lower: about  $20$  with  $30\text{ Hz}$ ). In the same way, if the entry signal is characterized by a particularly fine frequential discretization, it can prove to be relevant to use a list of frequencies defined consequently for the computation of the oscillator spectrum. Here still, the values by default can prove to be unsuited, and induce a loss of accuracy on the results thus calculated.