LSV 측정 정보를 이용한 ODS 와 OMA 의 동시분석 방법
How to get Operating Deflection Shape (ODS) and Operational Modal Analysis (OMA) with single measurement using LSV

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Key Words : Operational Modal Anaysis(운전 중 동적 특성), Operating Deflection Shape(운전 중 변형 형상),

1.

(,   ,   )

(ODS)   Operational Modal Analysis (OMA)   . OMA

ODS

White Noise

ODS   .

                                 2- 3

noise   OMA
       .   OMA
       . ODS   OMA

                     EM4SYS   Laser Scanning Vibrometer (LSV)   .
                          ODS   OMA

2.

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2.1 Operating Deflection Shape (ODS)

(ODS)

ODS FRF   [1].

$$\text{ODS FRF} = \frac{G_{y_{ref}y_i}}{\left|G_{y_{ref}y_i}\right|}\sqrt{G_{y_iy_i}} \times \frac{1}{M}\sum_{m=1}^{M}G_{y_{ref}y_{ref}} \quad (1)$$

(1) $G_{y_{ref}y_i}$ i

Cross $G_{y_iy_i}$ i   node
                    Auto   M
node   .

2.2 Operational Modal Analysis (OMA)

                                           Frequency Domain Decomposition(FDD)
    [2,3]. FDD
    (FRF)

$$\left[G_{yy}(\omega)\right] = \left[H(\omega)\right]^H \left[G_{xx}(\omega)\right]\left[H(\omega)\right]^T \quad (2)$$

$[G_{xx}(\ )]$ Input   , $[G_{yy}(\ )]$
Output   , $[H(\ )]$
    (FRF)   . $[G_{xx}(\ )]$
white noise   (2)

$$[G_{yy}(\ )] = [V][S][V]^H \quad (3)$$

(3)   Output   Singular Value Decomposition(SVD)

                                            .
                                            (3)

$$\left[G_{y_{ref}y_i}(\omega)\right] = [V][S][V]^H \quad (4)$$

(4) $\left[G_{y_{ref}y_i}(\omega) \right]$ 는 i 번째 node

Cross

. (1) ~ (4)

ODS 와 OMA

LMS 사의 CADA- X

표 4. OMA

3. OMA

3.1 OMA

OMA

표 2%

Modal Assurance Criterion (MAC)

OMA CADA-X	$\{\psi\}_1$	$\{\psi\}_2$	$\{\psi\}_3$	$\{\psi\}_4$	$\{\psi\}_5$
$\{\psi\}_1$	0.98273	0.06188	0.041013	0.036478	0.02415
$\{\psi\}_2$	0.02451	0.987455	0.041013	0.032891	0.01541
$\{\psi\}_3$	0.023777	0.08089	0.93237	0.126	0.126
$\{\psi\}_4$	0.0097108	0.019525	0.036478	0.91887	0.057609
$\{\psi\}_5$	0.032891	0.058354	0.10896	0.023777	0.91887

표 1. Modal Assurance Criterion (MAC) (CADA- X & OMA)

표 1 을 통해서 OMA 와 해머링 테스트 간의 결과
가 거의 일치하는 것을 확인 할 수 있다.

표 1   .

(a)   (b)
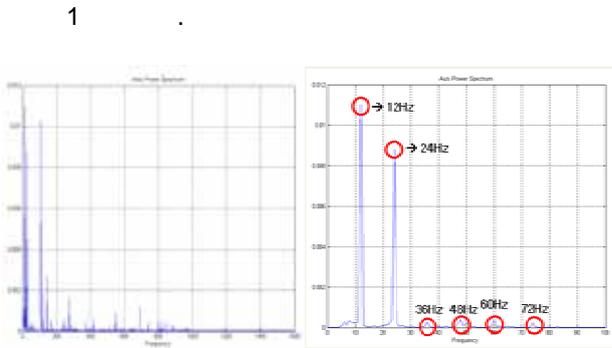
그림 1. Power spectrum. (a)   0- 1600Hz (b)
0- 100Hz.

4.

ODS 와 OMA

OMA

OMA

OMA

그림 1.(a)   Auto
1.(b)   (a)
.   1.(b)
12Hz

그림 2.   (12Hz)

5.
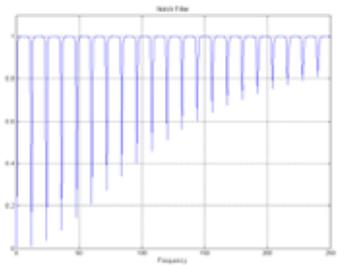
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그림 2
SVD   OMA

3.2

OMA