MatchID Metrology beyond colors

Airgun Dynamic Impact Test

Case Description

A bullet catcher tightly attached to a rack mechanism is impacted with a copper spherical bullet.

The damage caused by the bullet is recorded with 2 highspeed cameras from the opposite side of the catcher plate.

The dynamic response of the material is determined via an accurate DIC analysis relying on optimized settings obtained via our powerful performance analysis module.

Full-field operational deflection shapes are retrieved in the few kHz range.



Experimental Setup			Analysis		Results						
✓ ✓ ✓	Cameras: Phantom VEO 710 S and Phantom Miro 310 Light Source: Stroboscopic LED Acquisition Speed: 11000 Hz Field of View: 100 x 100 mm		 ✓ Type: Stereo DIC ✓ Calibration: MatchID Calibration with 50 calibration target images ✓ Signal To Noise: Setting optimization by MatchID performance analysis module 	v	 Stereo DIC: Time resolved displacements results FFT-Analysis: Frequency response of the structure Operational Deflection Shapes Extraction of mode shapes at natural frequencies 						
\checkmark	Fast bundle calibration approach including complex lens distortions										
\checkmark	Powerful performance analysis m	Why									
\checkmark	Higher-order shape functions yiel		MatchID								

✓ Detailed report generation



Optimized Processing Settings

Signal to noise ratio optimization relies on both static and deformed images imported into our Performance Analysis Module. The main quantity of interest is the out-of-plane motion of the bullet impact point. The settings corresponding to the highlighted point are then adopted for further DIC processing.

-0.375	inimum W (m	ml		Affine/O4		Setup Specifications	
		,		Affine/Q4		Camera 1 Noise (Miro 310)	0.55%
0.45	•			Quadratic	/Q4	Camera 2 Noise (VEO 710 S)	0.81%
0.45				Quadratic	/Q8	Resolution (Pixels)	512x512
						Frame Rate (FPS)	11000
-0.525	-					Processing Settings	
						Subset size	21 [pixels]
			Highest			Step size	5 [pixels]
-0.6			Signal to No	oise Ratio	Ratio	Correlation Criterion	ZNSSD
		SS= 21 ST=5 Quadratic SF				Correlation Shape Function	Quadratic
			/			Stereo Shape Function	Affine
-0.675		-/	/			Interpolation	Bicubic Spline
		()				Displacement Resolution	
		\cup		Resolution W [r	mm]	In plane	0.0027 mm
-0.75 0.00299	0.00497	74 0.0069	56 0.0089	0.01092	0.01	Out of plane	0.0063mm

The shape of the circular wave originating from the hit point is depicted in the figure below. The maximum displacement recorded in the out-of-plane direction increase from 0.66 mm to 0.40 mm in one single timestep. This impact resembles a hammer effect on the steel plate and creates a vibrational response of the plate. The first hit wave causes a peak in displacement and slowly dampens. Within the analysis interval, the damping still continues, and the fluctuations persist through the domain with lower amplitude.



The impact creates a spectral response on the steel plate reflecting the natural frequencies. Our embedded FFT tool is used to extract this response in the frequency domain. Finally, an integrated ODS implementation allows to disentangle full-field operational deflection shapes at these determined natural frequencies.

