

Analysing Engine Behaviour through High- Speed Video

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Overview

- Background to Application Domain
- Data Capture with High Speed Video
- Data Analysis via Image Processing
- Examples
- Benefits
- Conclusions

Background to Application Domain

- Investigating Engine Vibration
 - Reduce Engine Wear
 - Reduce Noise
- Investigate Belt Behaviour
 - Increase belt life (time between change / failure)
 - Increase life of belt driven components

Data Capture with High Speed Video

- High Speed Cameras
 - More affordable (< €12,000 for 500fps Mega-Pixel resolution)
 - Multi Application (share the cost)
- Film at 500 + fps (up to 210,000fps!)
 - 6000 rpm = 100 rps
 - 1000 fps gives 10 frames per revolution
 - Viewing at “natural” speed of engine phenomena
- Non-Intrusive
- Non-Contact
- No Special Preparation
- Immediate Conceptual understanding

High Speed Video (2)



Micro Camera Heads (lipstick) for easy access



Cost Effective Solutions



High Frame Rates {>150,000fps}



Multiple heads for synchronised capture

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High Speed Video (3)

- Easy to set-up and use
- Auto-Calibrating
- General Purpose device
 - Many areas of use
- Standard Lenses & Lights
 - Flexibility
 - High resolution (quantitative measurements)
 - Wide field of view (context)

High Speed Video (4)



1000 fps, 1/2000 shutter (exposure)

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Analysing the Results

- Conceptual Understanding
- Automated Tracking
- Measurements
 - Displacements
 - Vibration Frequencies
 - RMS, Peak to Peak, Mean, Crest etc
- Synchronised review
- Simplified Reporting across development chain
- Test Comparisons

Using the Software



Patent Pending

Video Vibration Analysis

Software demo

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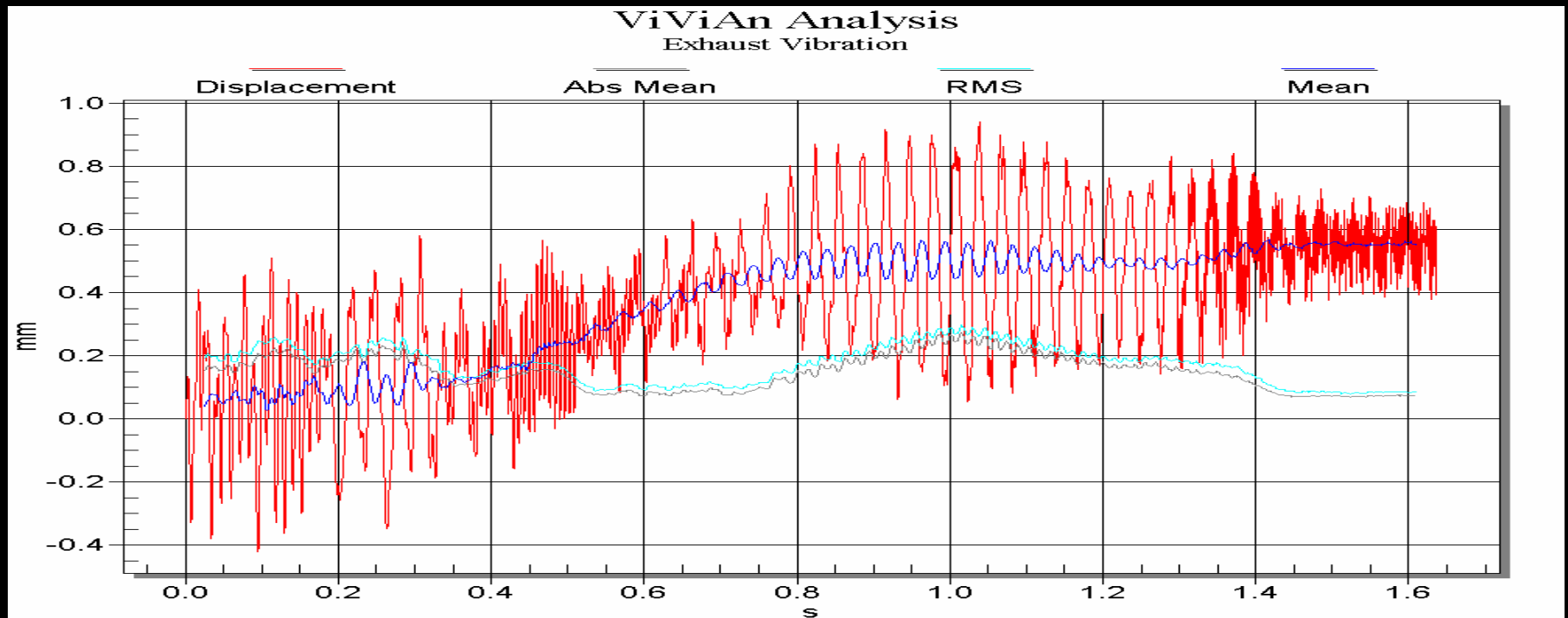
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Advantages

- Easy Set-up
- Non-Contact / Non Invasive
- Full Belt length Tracking
- Twist Measurements
- Absolute Displacement (e.g., exhaust lift)
- Easy to correlate measurements to physical phenomenon
- Easy to report & distribute

Further Examples



- HS Video Gives Spacial Displacement

Conclusions

- High Speed Video is now an affordable general purpose tool for the engine test lab
- Allows investigation of a range of phenomena at the natural speed of the engine
- Immediate slow motion playback for intuitive understanding
- Use of sophisticated image analysis software for quantitative measurement of displacement and amplitude of frequency components

Thanks

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