

LEAK DETECTION IN PIPELINES USING WAVELET AND CEPSTRUM  
ANALYSIS

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Report submitted in partial fulfillment of requirements  
for award of the Degree of  
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**BORANG PENGESAHAN STATUS TESIS♦**

JUDUL: **LEAKAGE DETECTION IN PIPELINES USING  
WAVELET AND CEPSTRUM ANALYSIS**

SESI PENGAJIAN: 2012/2013

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**LIST OF ABBREVIATIONS**

|      |                              |
|------|------------------------------|
| CWT  | Continuous Wavelet Transform |
| DWT  | Discrete Wavelet Transform   |
| MDPE | Medium Density Polyethylene  |
| GI   | Galvanized Iron              |
| STFT | Short Time Fourier Transform |
| FT   | Fourier Transform            |

## NOMENCLATURES

|             |   |
|-------------|---|
| VB          | Volume Balance  |
| $Q_{in}$    | Supply flow into pipeline   |
| $Q_{out}$   | Delivery flow out of the pipeline   |
| M           | Mass of the fluid contained in the pipeline   |
| C           | Wave propagation speed  |
| $\rho$      | Density of the fluid  |
| K           | Bulk modulus of the liquid  |
| E           | Young's modulus of the pipe material  |
| $\emptyset$ | Restraint factor dependent on the Poisson's ratio of the wall material and how well the pipe is supported |
| D           | Diameter of the pipe  |
| e           | Wall thickness of the pipe  |
| P           | Wall thickness of the pipe  |
| PI          | Inlet pressure  |
| V           | Flow velocity   |
| t           | Valve closing time  |
| L           | Upstream pipe length  |
| x(f)        | Fourier transform   |
| x(t)        | Continuous function in time   |
| j           | $\sqrt{-1}$   |
| Q(a, b)     | Wavelet coefficients and a and b are the scale (dilation)   |
| y(t)        | vibration response signal   |
| $\varphi$   | the complex conjugate of the basis function   |