



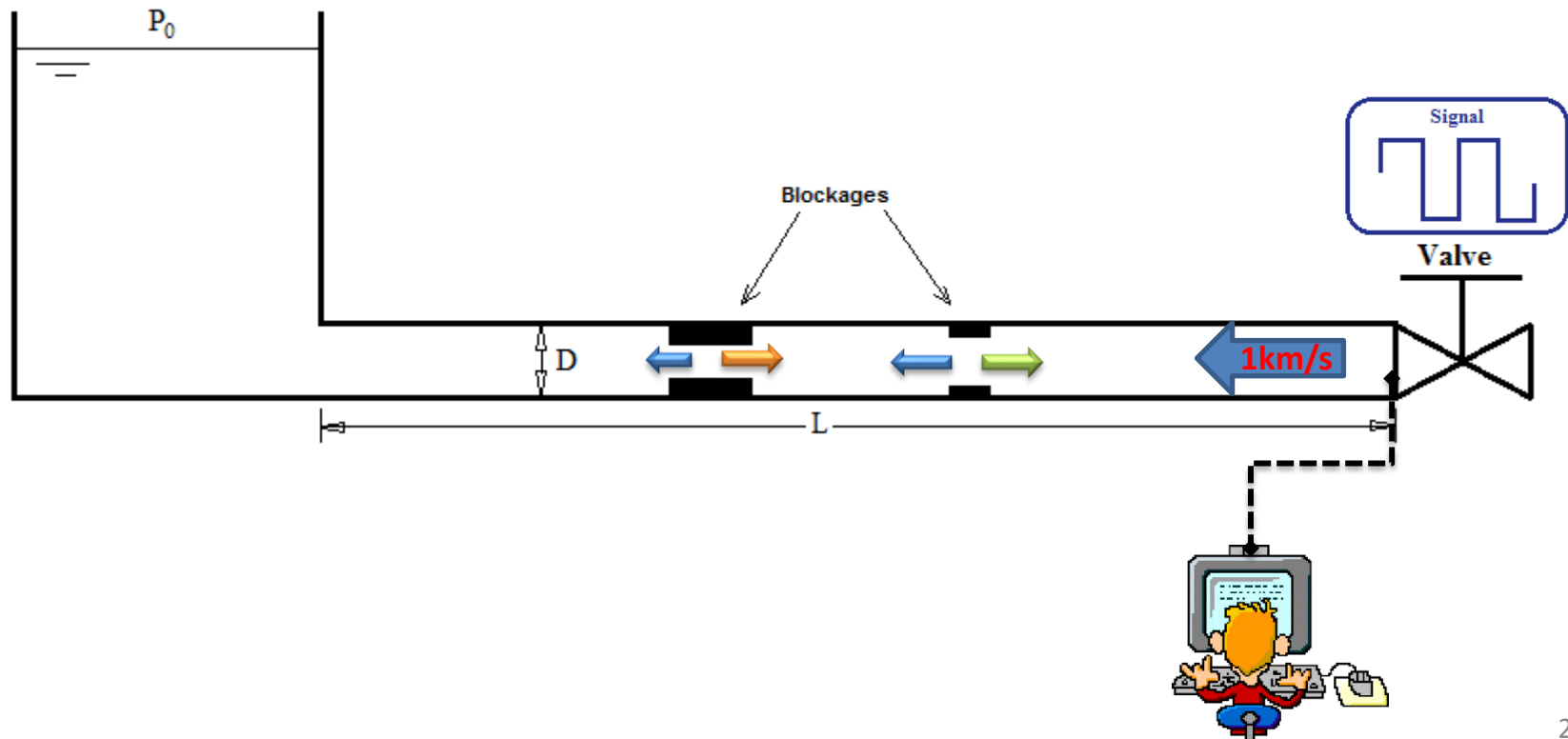
Role of High Frequency Waves in Acoustic Imaging of UWSS

Moez LOUATI

PhD Student



Principle of Transient-based methods





Fastest valve closure time : 5ms-50ms

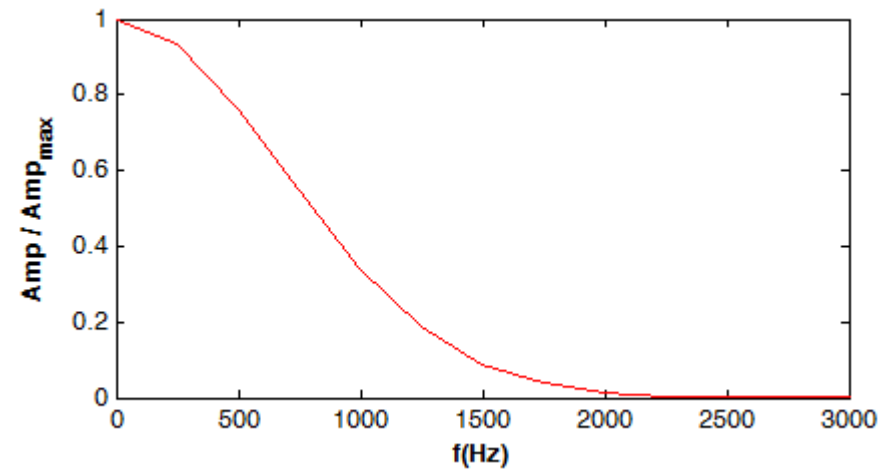
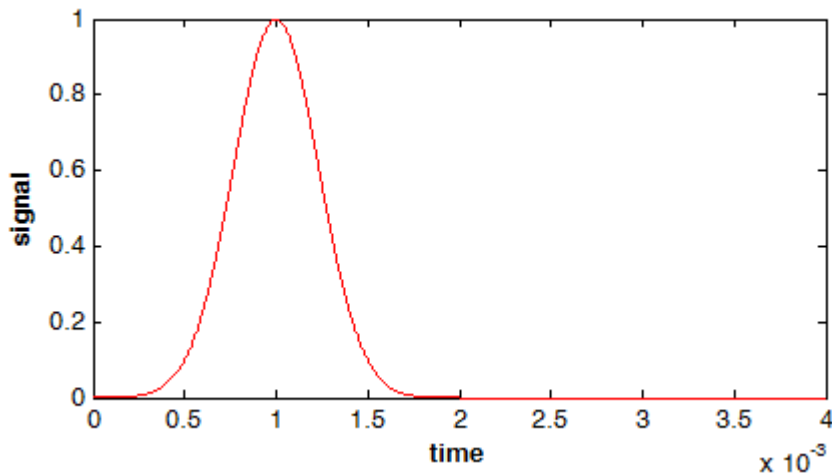
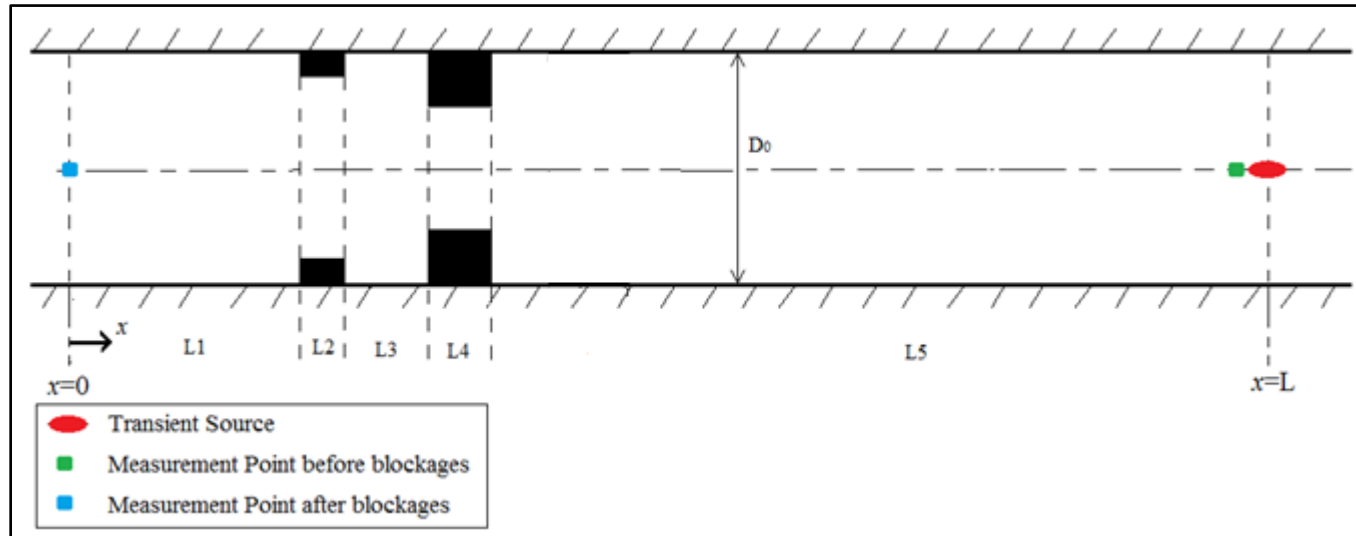


Frequency range: 20Hz - 200Hz

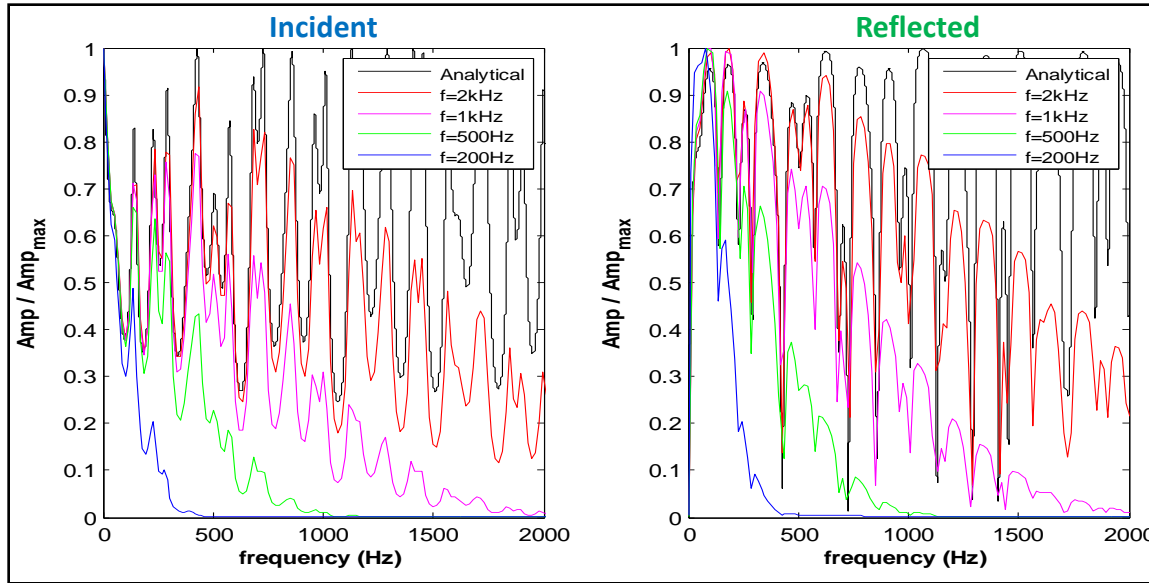
Is it enough ?



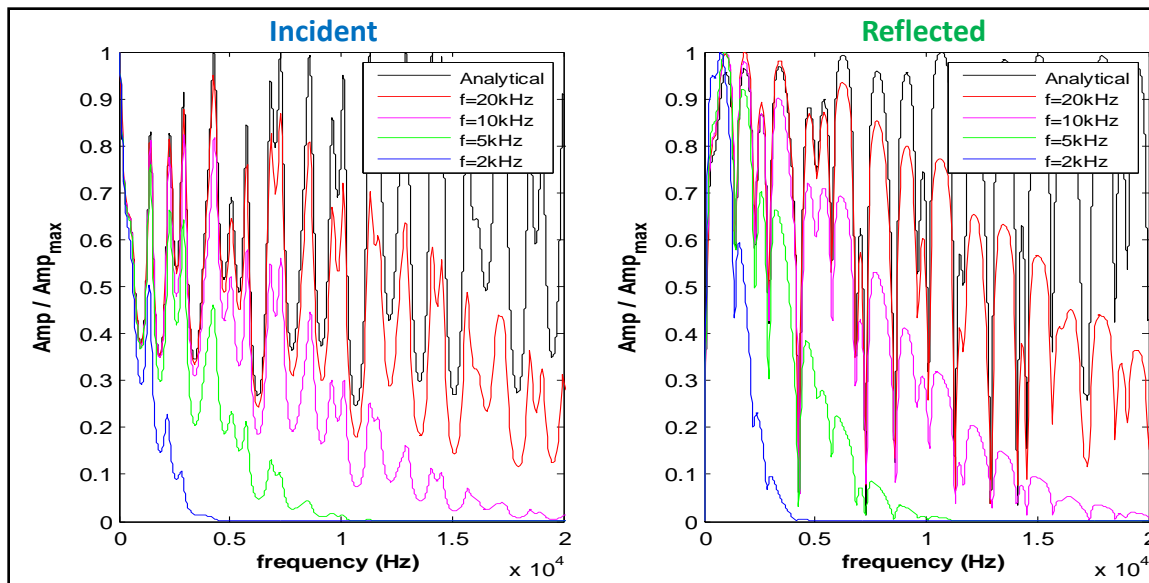
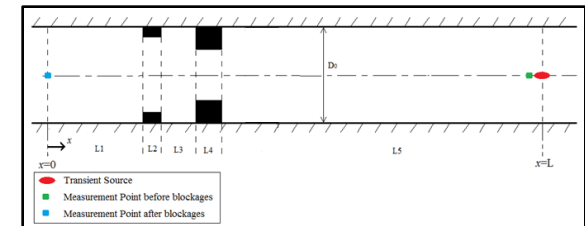
Stagnant flow in a defected pipe



Smart Urban Water Systems – defect localization and acoustic communication in water



L2	D2/D ₀	L3	D3/D ₀	L4	D4/D ₀
1.2m	0.7	2.1m	1	3.5m	0.5

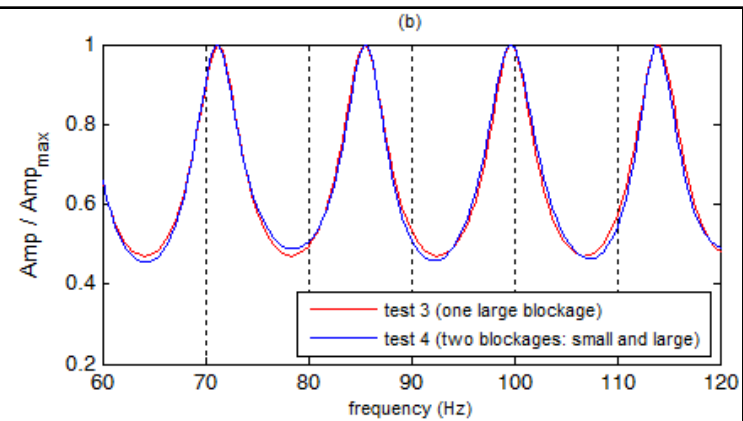
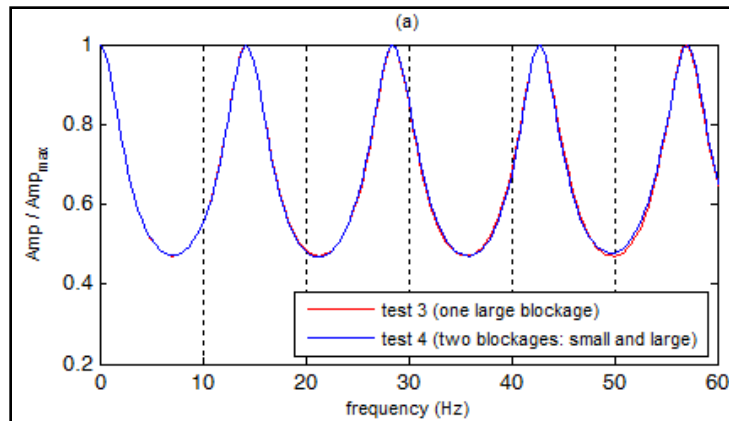
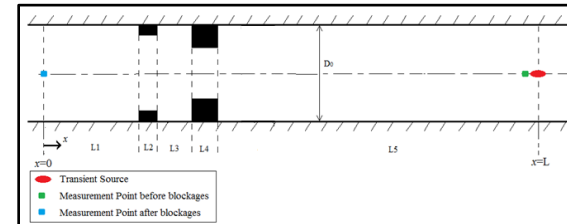


L2	D2/D ₀	L3	D3/D ₀	L4	D4/D ₀
0.12m	0.7	0.21m	1	0.35m	0.5

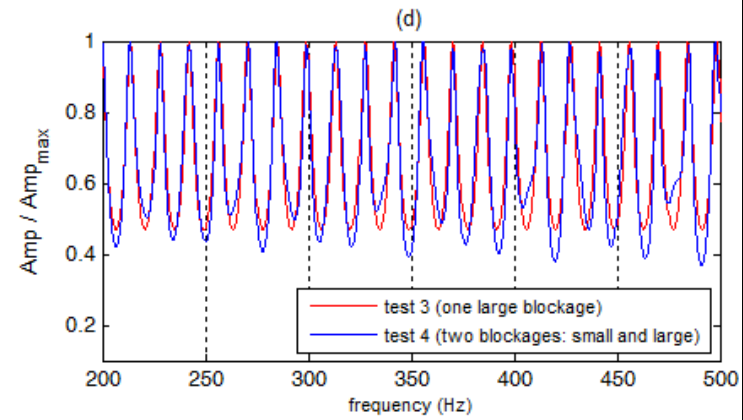
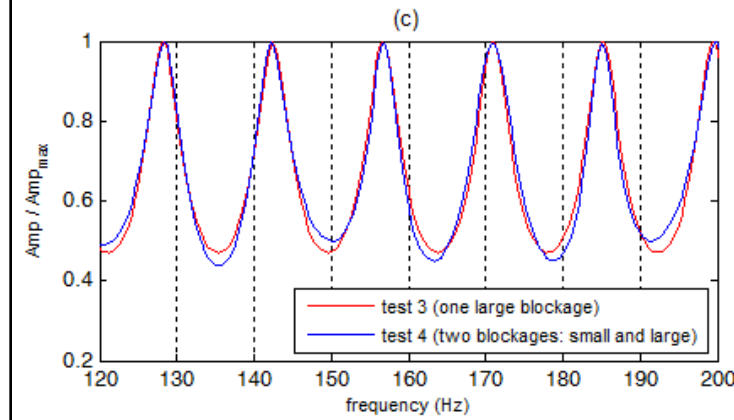
Smart Urban Water Systems – defect localization and acoustic communication in water



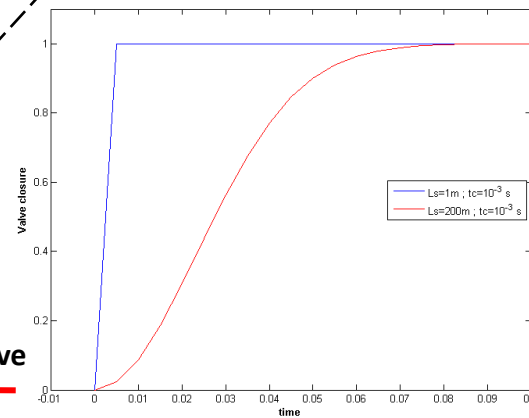
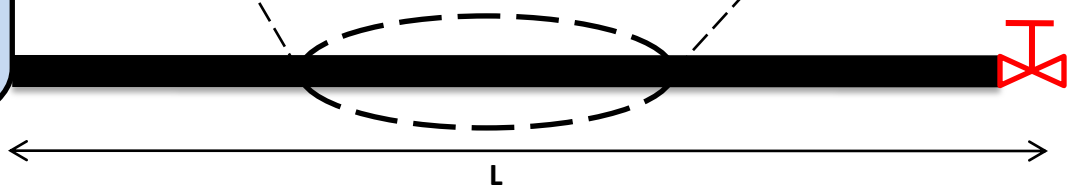
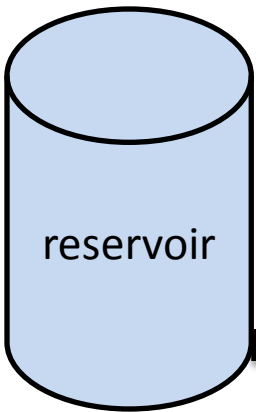
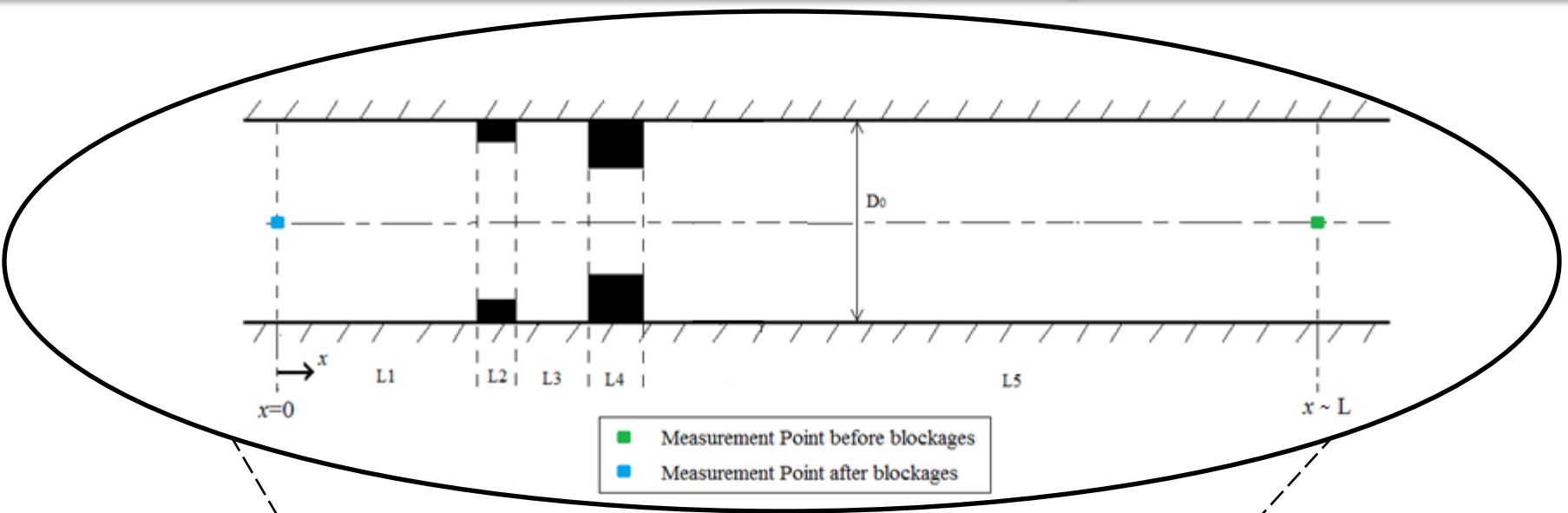
L2	D2/D ₀	L3	D3/D ₀	L4	D4/D ₀
0.12m (0)	0.7	21.1m	1	35.1m	0.5



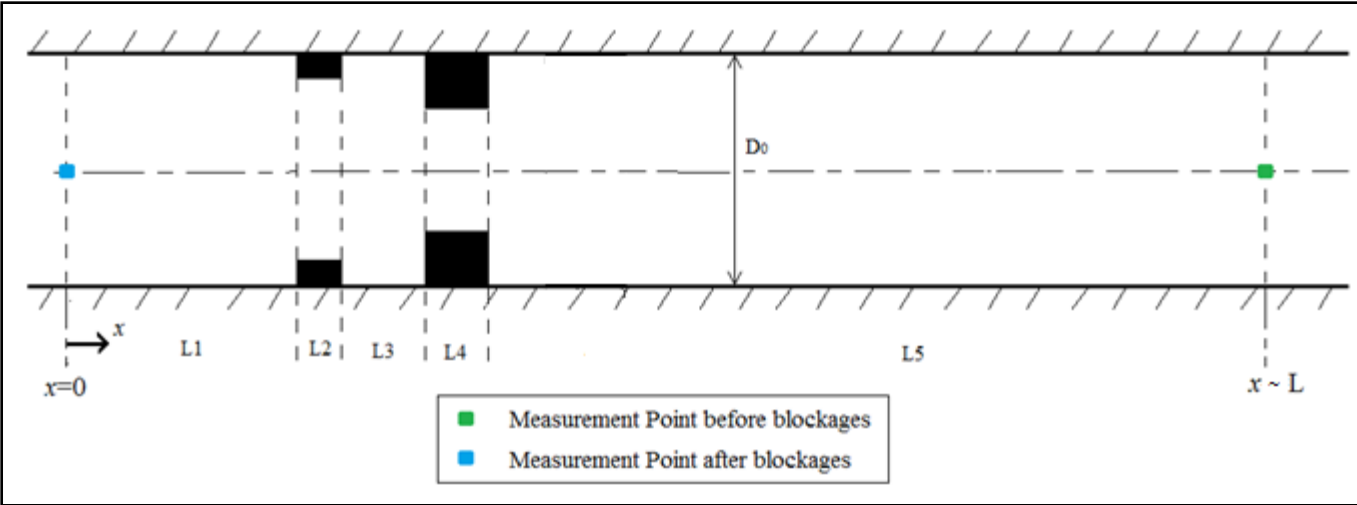
Incident



Smart Urban Water Systems – defect localization and acoustic communication in water

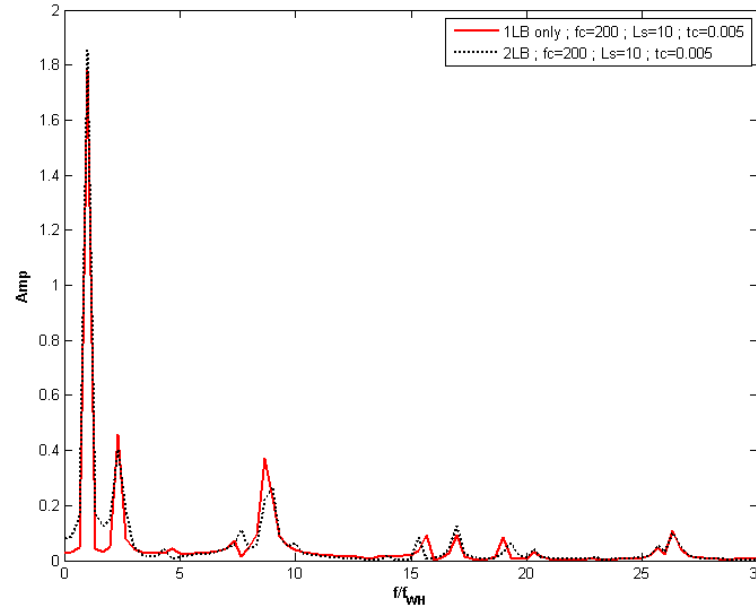
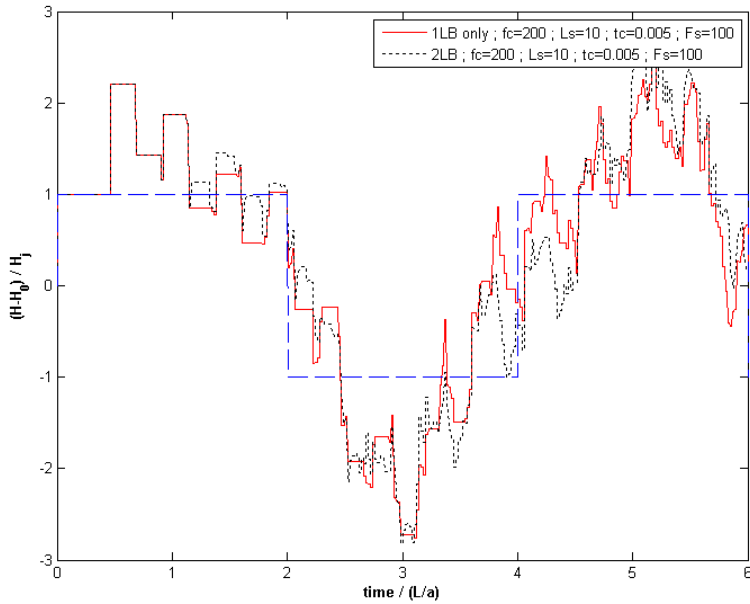


Smart Urban Water Systems – defect localization and acoustic communication in water

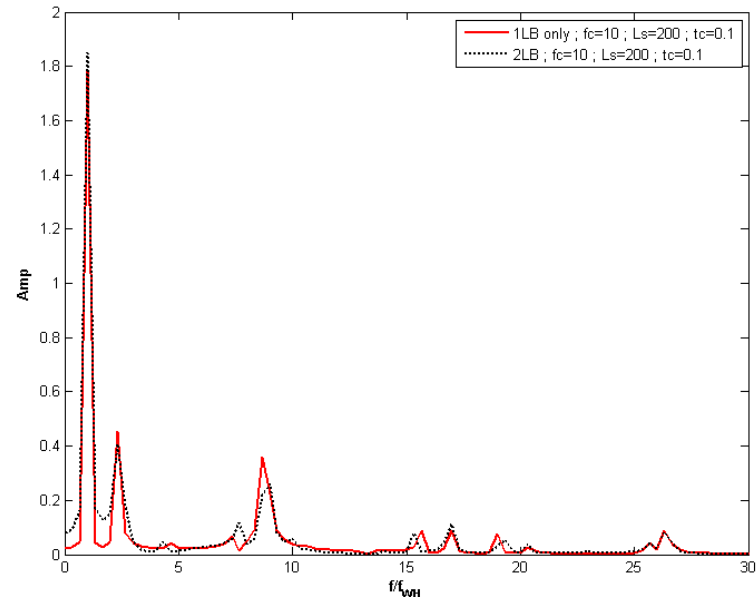
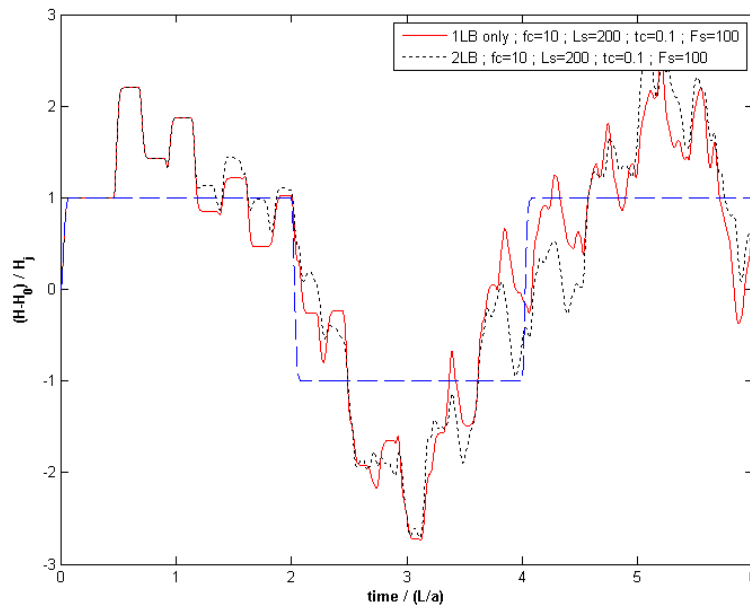


L	L1	$D1/D_0$	L2	$D2/D_0$	L3	$D3/D_0$	L4	$D4/D_0$	L5	$D5/D_0$
2000m	680m	1	160m	0.7	480m	1	220m	0.5	460m	1

Smart Urban Water Systems – defect localization and acoustic communication in water

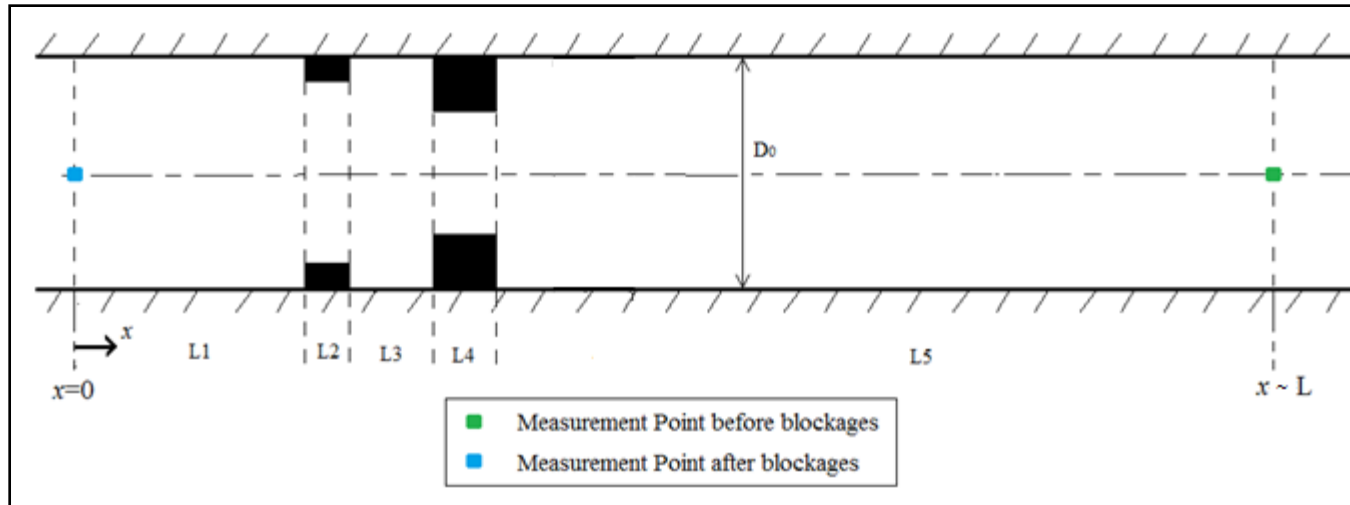


Ls=10 m



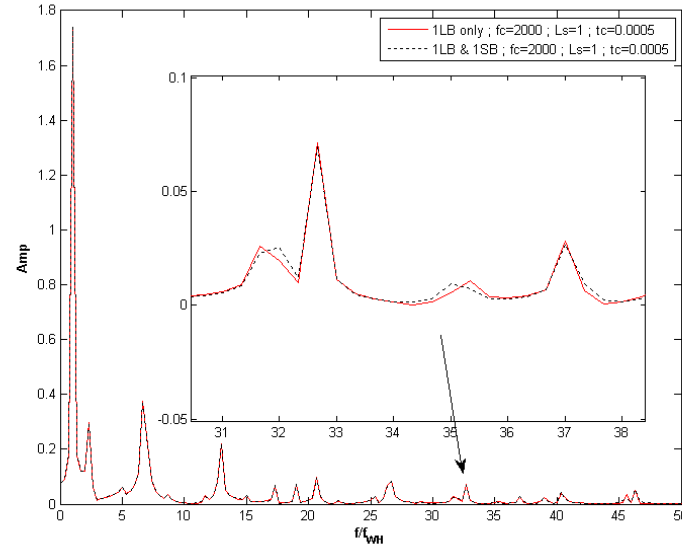
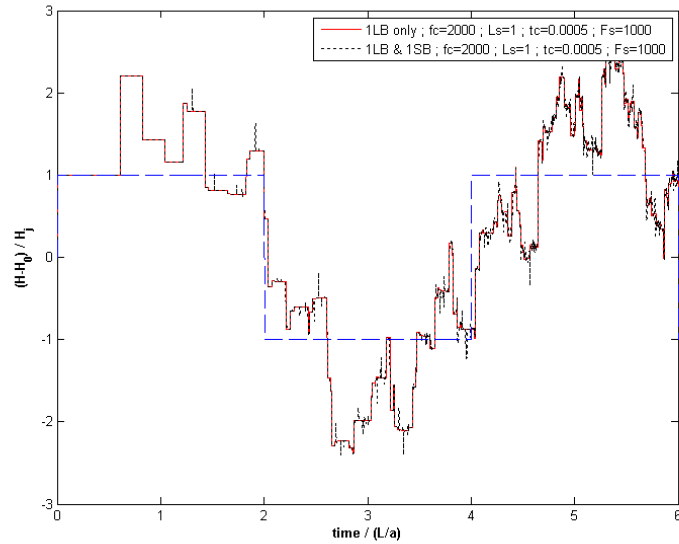
Ls=200 m

Smart Urban Water Systems – defect localization and acoustic communication in water

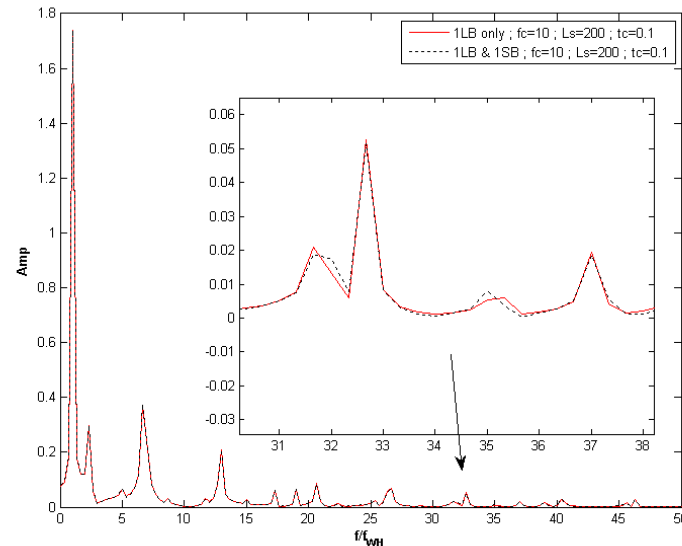
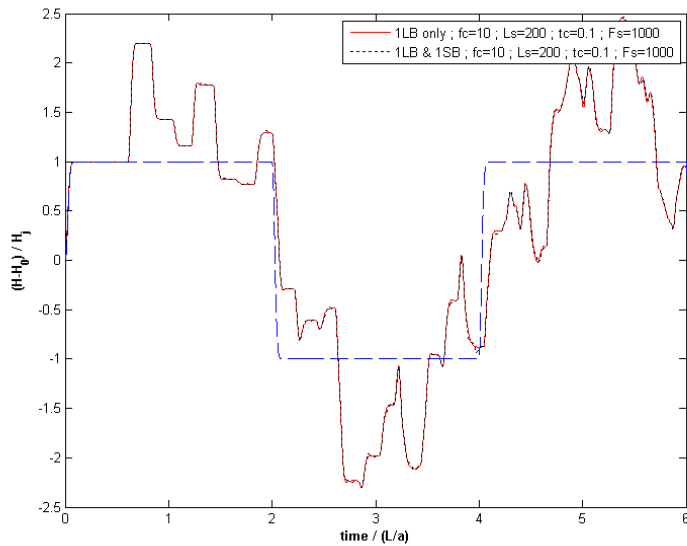


L	L1	D1/D ₀	L2	D2/D ₀	L3	D3/D ₀	L4	D4/D ₀	L5	D5/D ₀
2000m	691m	1	3m	0.7	486m	1	213m	0.5	610m	1

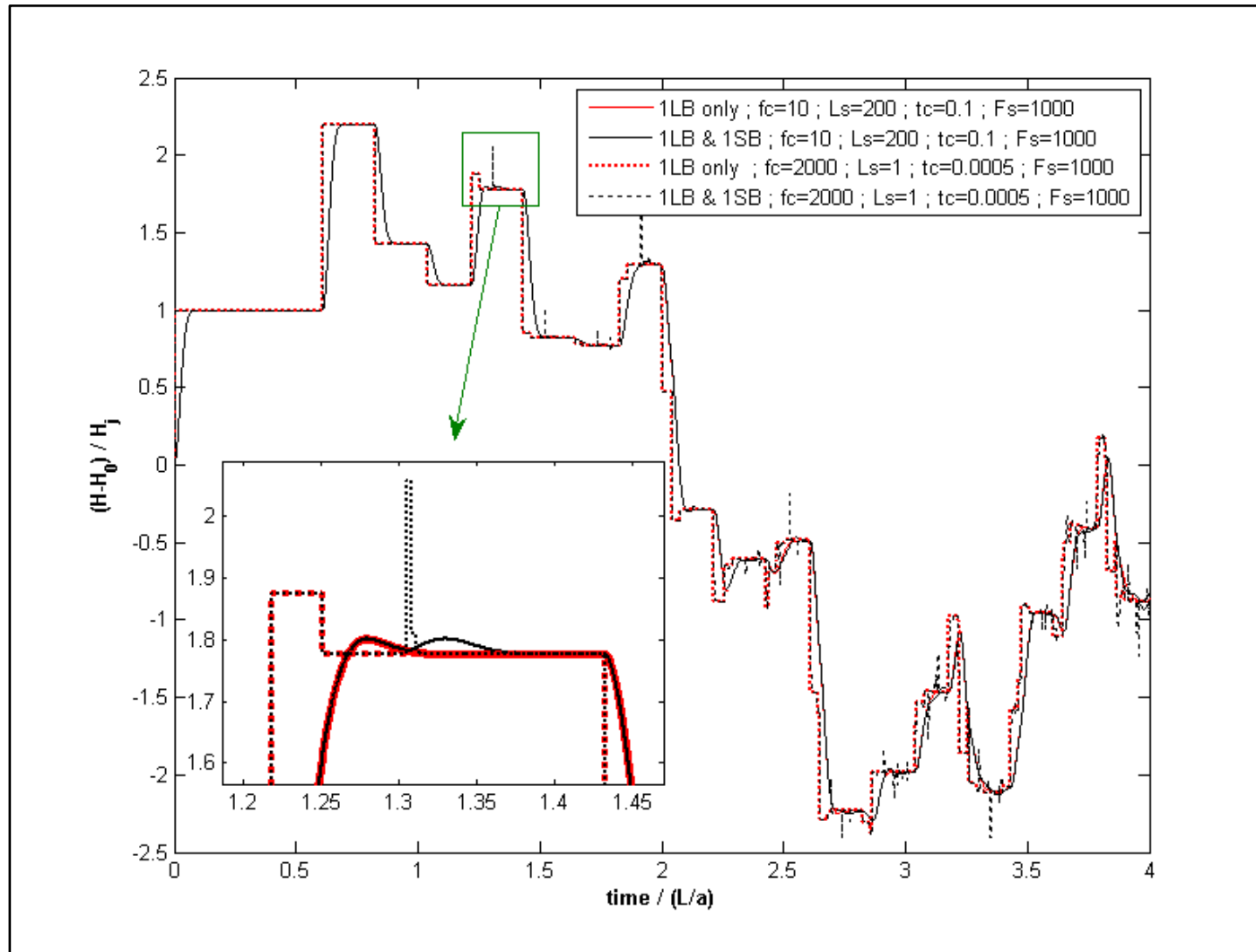
Smart Urban Water Systems – defect localization and acoustic communication in water

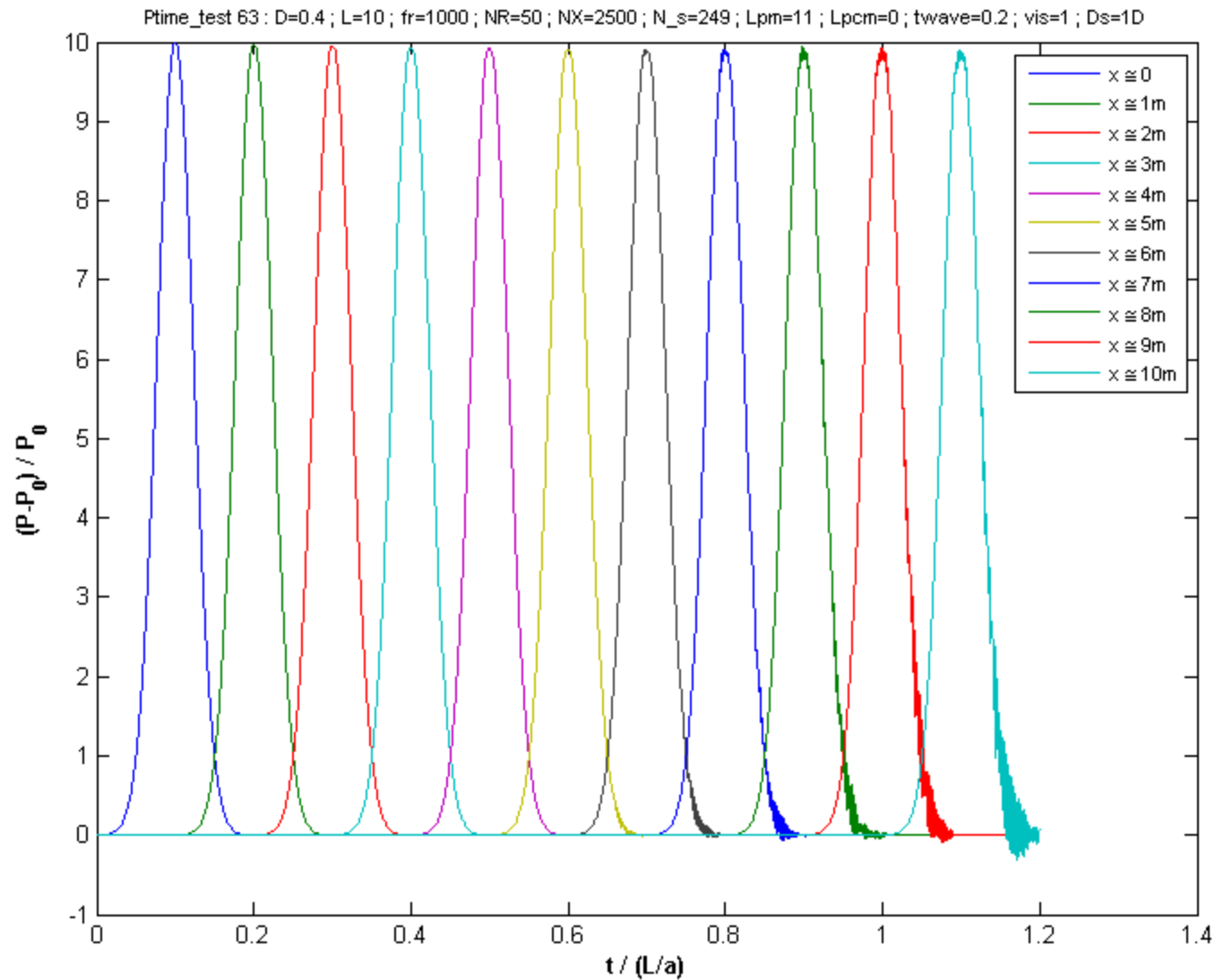


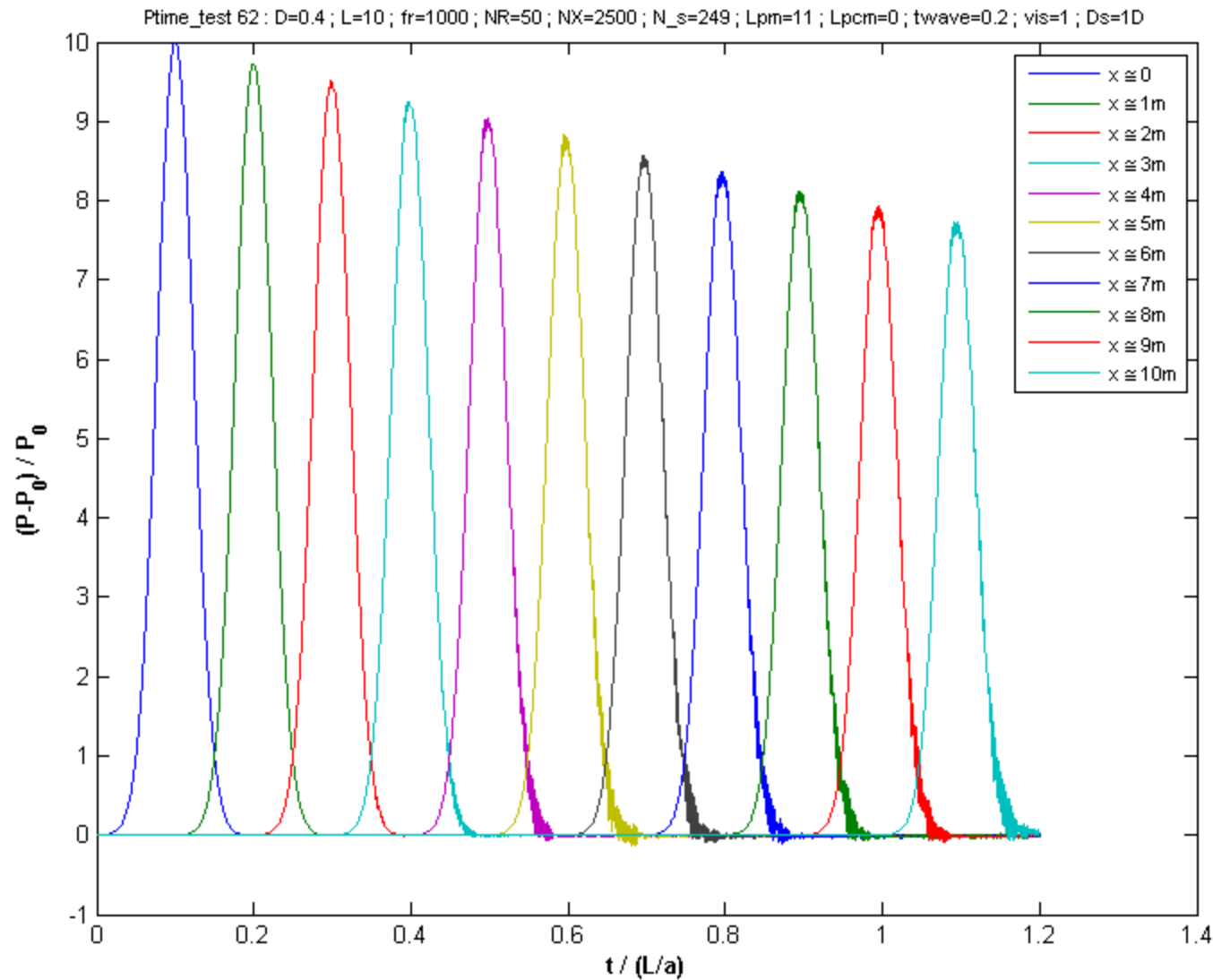
$L_s = 1$ m



$L_s = 200$ m



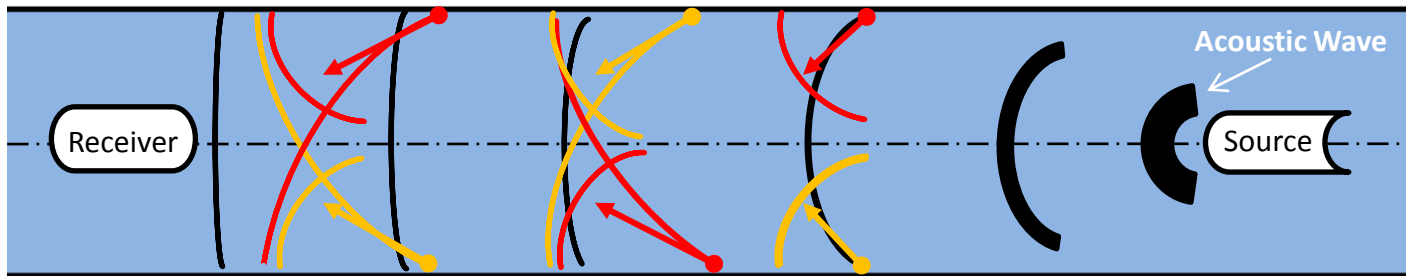






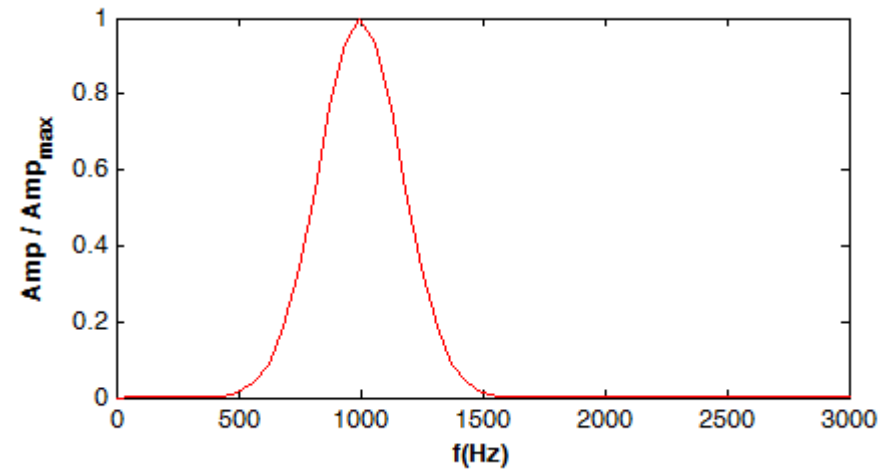
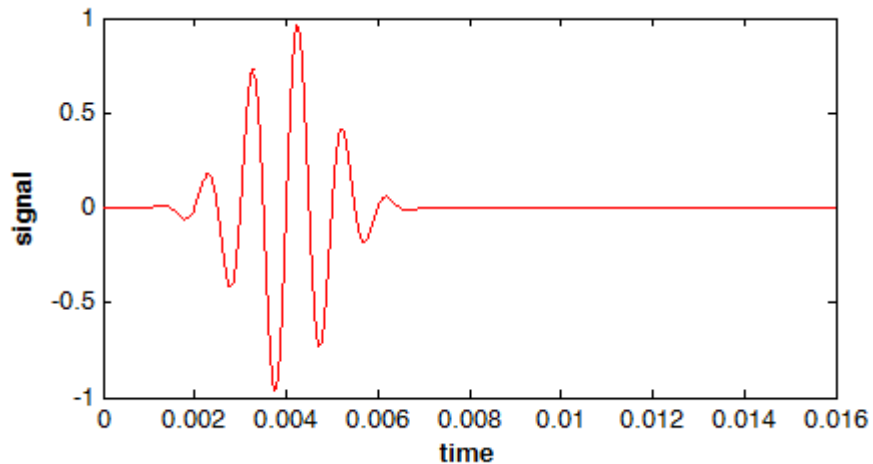
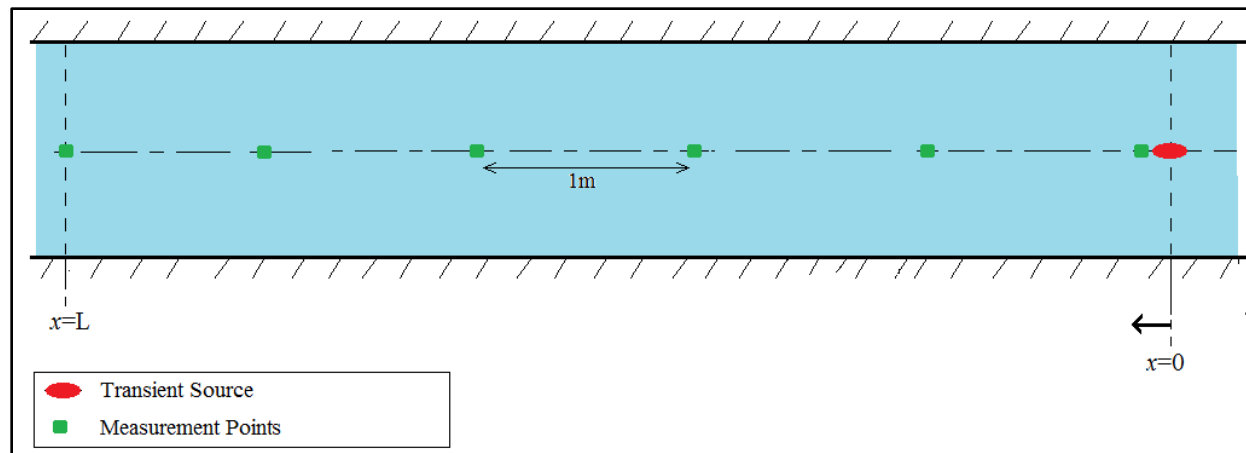
Dispersion and multipath at high frequency wave

Multipath effect



$$fD > \frac{3.8}{\pi} a$$

Stagnant flow in a defected pipe



Smart Urban Water Systems – defect localization and acoustic communication in water



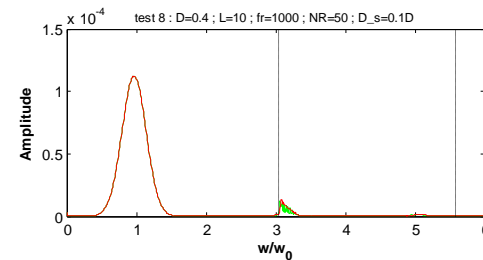
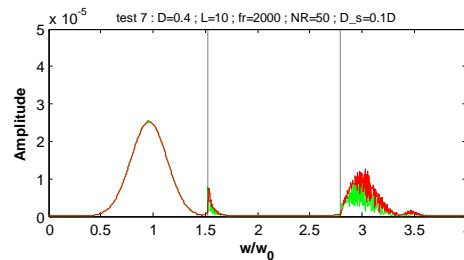
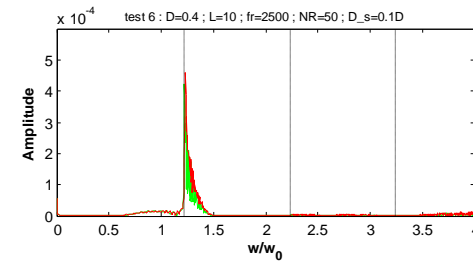
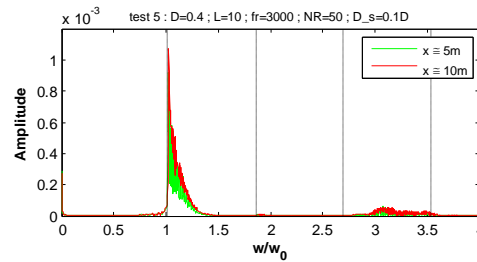
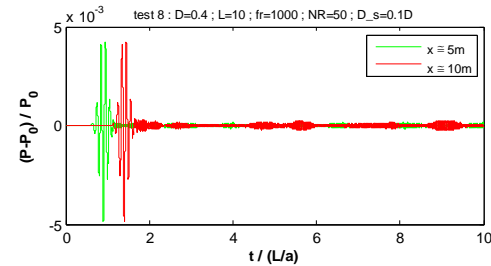
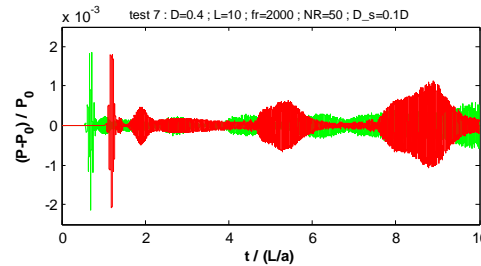
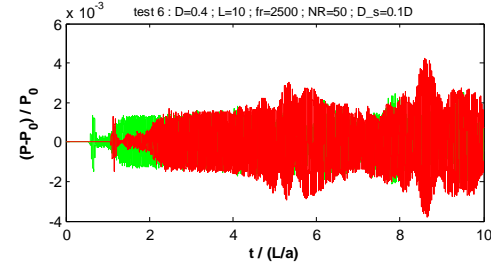
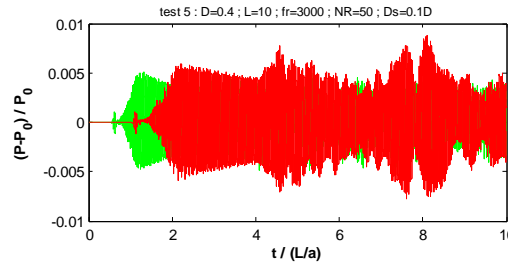
$$fD > \frac{3.8}{\pi} a$$



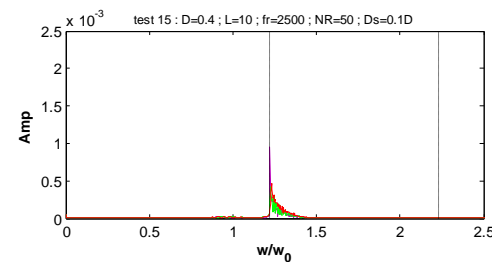
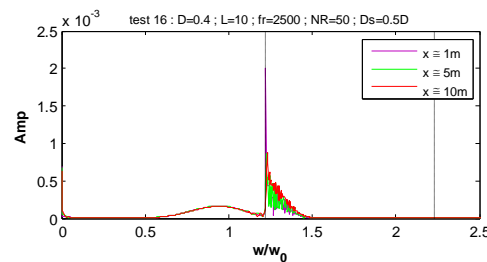
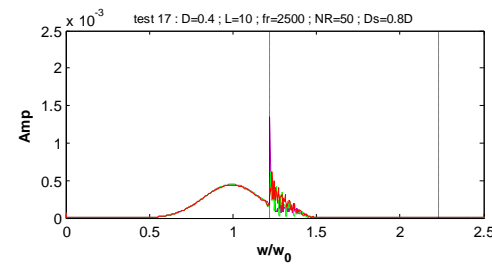
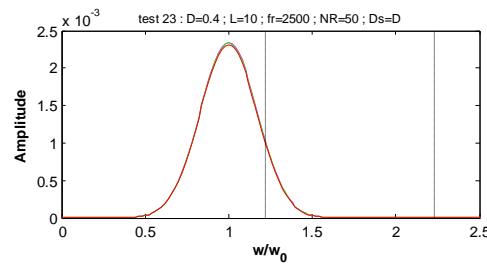
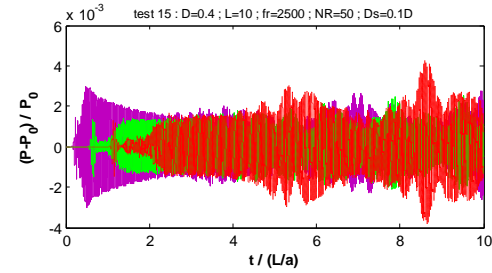
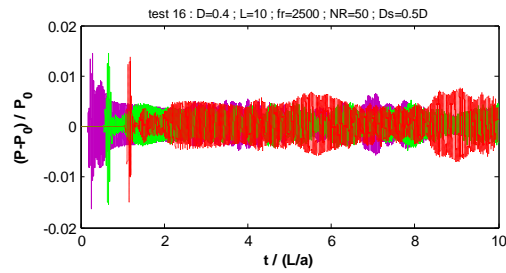
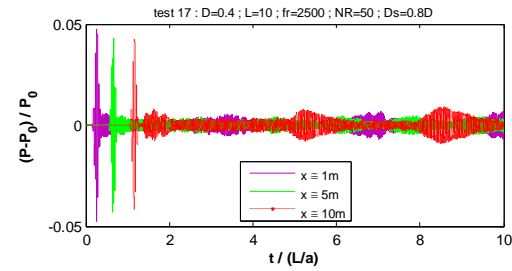
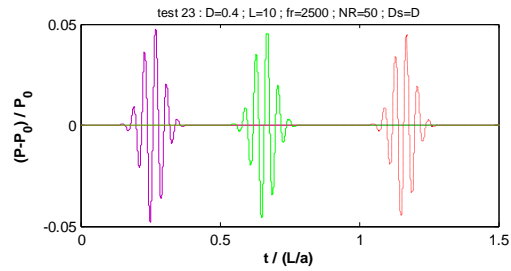
$$f > \frac{3.8}{\pi} \frac{a}{D}$$



$$f > \frac{3.8}{\pi} \frac{1000}{0.4} \approx 3000 \text{ Hz}$$



Smart Urban Water Systems – defect localization and acoustic communication in water





THANK YOU