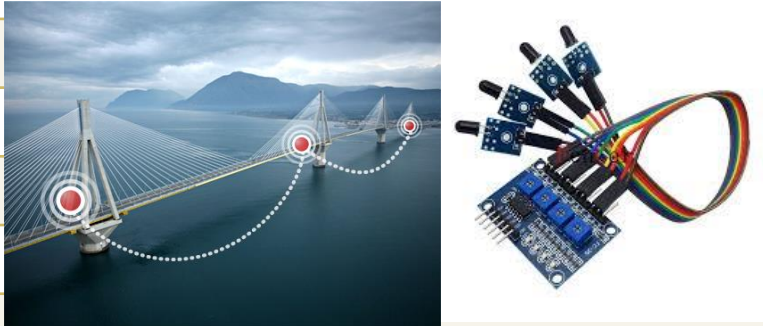


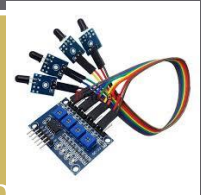
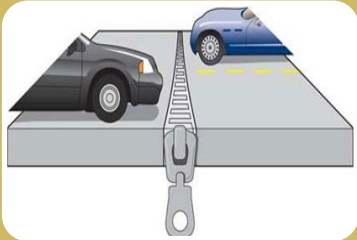
Dipartimento:	DIIES	
Corso di laurea:	Laurea Magistrale in Ingegneria Elettronica	
Classe:	LM29	
Tipo Attività formativa:	A scelta	
Ambito disciplinare:	ICAR	
SSD	ICAR04	
Numero CFU	6	
Anno di corso:	2	
Semestre:	2	
Ore di insegnamento:	24+24	

Smart road technologies and performance



Prof. Filippo G. Praticò

OBIETTIVI FORMATIVI



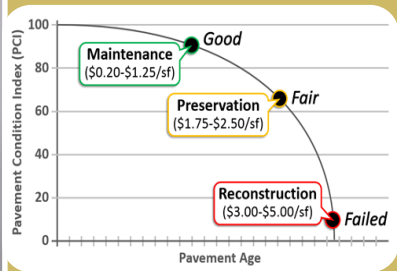
1. Conoscenza e capacità di comprensione (Acquisizione di specifiche competenze teoriche e operative in materia di Dispositivi e sistemi di monitoraggio infrastrutturale per le smart roads).

2. Capacità di applicare conoscenza e comprensione

3. Autonomia di giudizio (Valutazione e interpretazione dei dati sperimentali propri del settore).

4. Abilità comunicative.

5. Capacità di apprendimento con riferimento ai temi tratti diffusamente ivi inclusi quelli secondari.

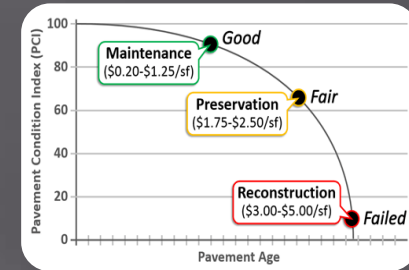
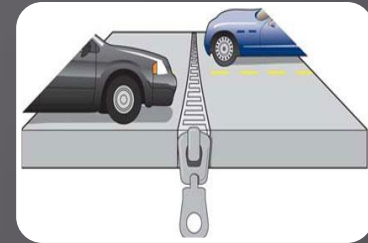
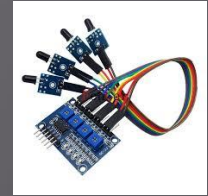
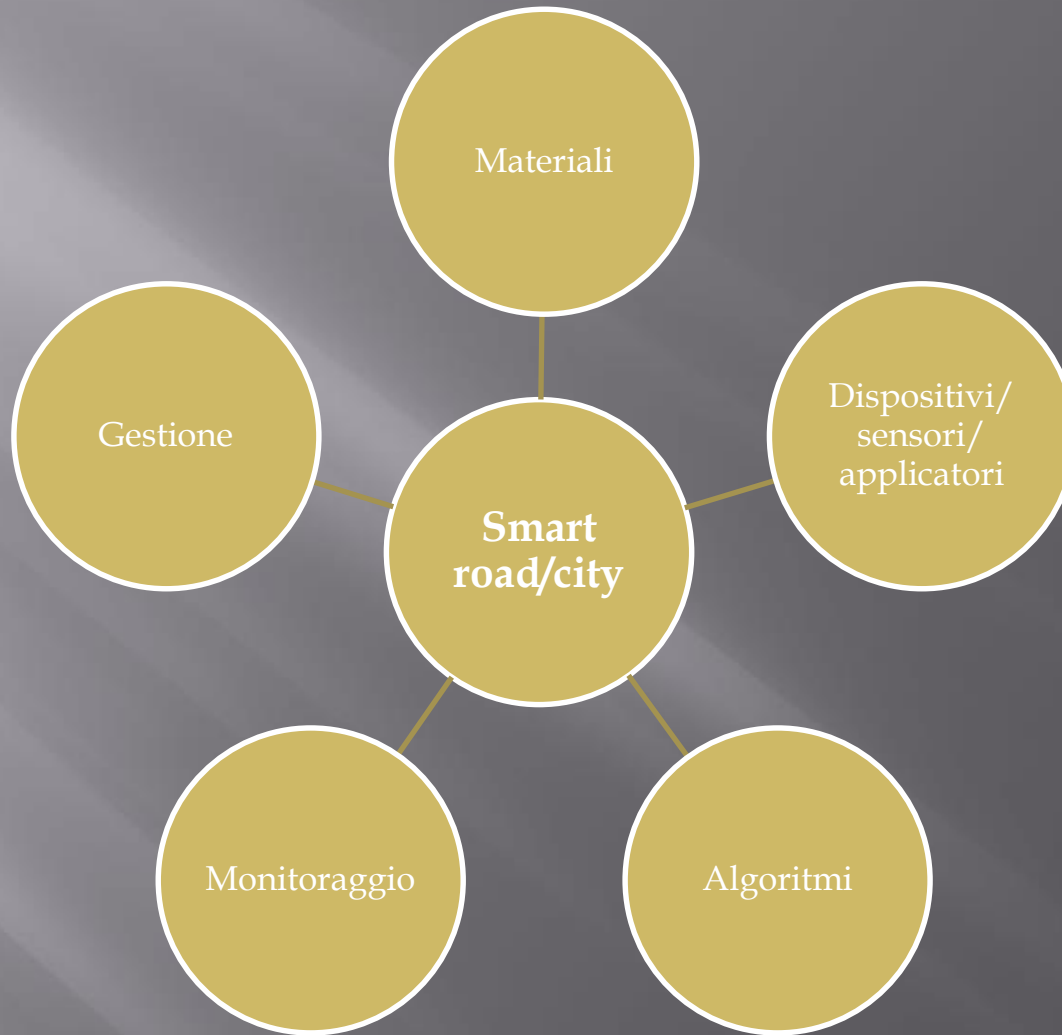


Smart road technologies and performance



Prof. Filippo G. Praticò

Temi



Smart road technologies and performance



Aspetti salienti programma

- ▣ Materiali, sistemi e tecnologie per le infrastrutture di trasporto (visite Laboratori)
- ▣ Gestione e monitoraggio del patrimonio infrastrutturale (visita al prototipo)
- ▣ Algoritmi e modellistica avanzata per l'analisi
- ▣ Analisi comparata sistemi di monitoraggio e prospettive della ingegneria elettronica al servizio dei sistemi di trasporto (visite prototipi)
- ▣ Dispositivi e Sistemi di monitoraggio trasporto (visite prototipi)
- ▣ Esempi di smart roads
- ▣ Strade solari (visite)
- ▣ Induction heating (simulazioni multiphysics)
- ▣ Sono previste attività di laboratorio personalizzate in ciascuno dei moduli sopra.

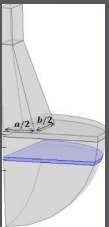
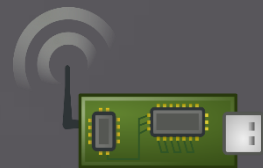
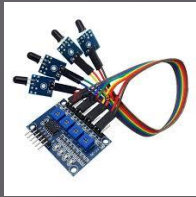
Moduli didattici principali: M25; M115M; M_129; M190; M290_3; 290_8 e 290_9; 290_13

Modalità di valutazione

- ▣ Esame orale con discussione elaborato.
- ▣ Voto finale (≤ 30) = voto progetto (≤ 15) + voto orale (≤ 15). Il progetto consta di 2 parti principali: 1) riassunto del corso. 2) relazione a tema. Esso è corredato da approfondita analisi bibliografica. L'esame orale include: la discussione di un argomento trattato a lezione; la discussione di una tecnologia (relazione a tema).
- ▣ Agli studenti che abbiano acquisito competenze eccellenti sia nel rapporto scritto che all'orale può essere attribuita la lode.

Esempi di risorse bibliografiche

1. Praticó F.G. (2011). QA/QC in Transport Infrastructures: Issues and Perspectives, Modern Approaches To Quality Control, Ahmed Badr Eldin (Ed.), ISBN: 978-953-307-971-4, InTech, Available from:
<http://www.intechopen.com/articles/show/title/qa-qc-in-transport-infrastructures-issues-and-perspectives>, pp.181-206
2. Lajnef, N., Chatti, K., Chakrabartty, S., Rhimi, M. and Sarkar, P.(2013). Smart Pavement Monitoring System, Publication No. FHWA-HRT-12-072.
3. Pavement Condition Monitoring With Connected Vehicle Data (2013). Center for Automotive Research, State Planning and Research Grant administered by the Michigan Department of Transportation.
4. Fedele R., Merenda, M., Praticò F.G., Carotenuto R., and Della Corte F.G., Energy harvesting solutions for powering IoT innovative road pavement monitoring systems, INSTRUMENTATION MESURE METROLOGIE, Vol.17, n.4, 2018,
5. Walls III, J. Smith, M.R. (1998). Life-Cycle Cost Analysis in Pavement Design – Interim Technical Bulletin.
6. Bevacqua, M.T., Isernia, T., Praticò, F.G., Zumbo, S., A method for Bottom-up cracks healing via selective and deep microwave heating To be published in: Automation in Construction



Smart road technologies and performance

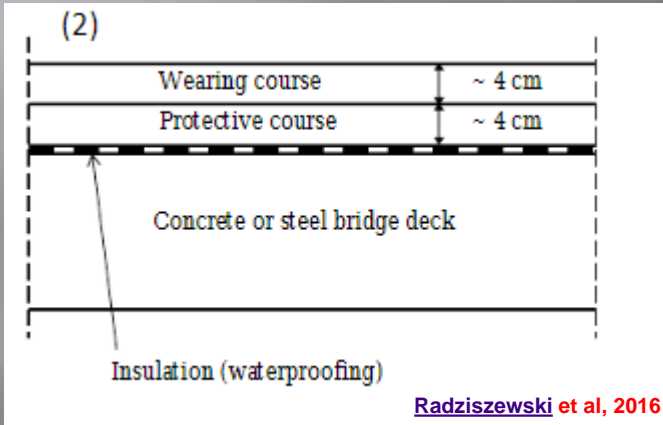
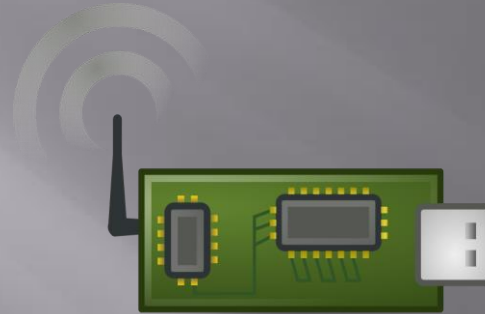
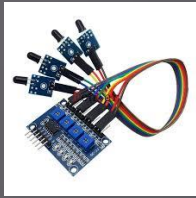


Prof. Filippo G. Praticò

Che faremo in pratica?

1. **Breve introduzione al corso**
(lezioni spesso individuali,
sovente in laboratorio-visite
presso industrie /Laboratorio)
2. **Tesina (elaborato)**
3. **Esame: Discussione esperienze
ed elaborato**

...Monitoraggio.. Significa...



Smart road technologies and performance



Smart cities significa..

- ▣ Smart cities=
- ▣ Smart transport +
- ▣ Smart infrastructure+
- ▣ Smart environment+
- ▣ Smart utilities+
- ▣ Smart buildings+
- ▣ Smart life

Smart cities= Smart transport + Smart infrastructure+ Smart environment+
Smart utilities+ Smart buildings+ Smart life

Smart transport	Smart infrastructure	Smart environment	Smart utilities	Smart buildings	Smart life
<u>electric transport;</u> <u>traffic control</u> <u>/ smart roads;</u> <u>fast lanes</u>	Vertical axis wind turbines; Waste management ; <u>Smart lighting;</u> <u>Structural health;</u>	<u>Green buildings</u> <u>Rooftop wind turbines;</u> <u>Air pollution control;</u> <u>Building-integrated photovoltaics;</u> <u>Smart parking;</u> <u>Earthquake early detection;</u> <u>Landslide and avalanche prevention</u>	Smart grid; Chemical leakage detection; <u>Real-time updates (traffic);</u> Potable water monitoring; Water leakage detection;	Building management; Perimetral access control; Fire safety	<u>WI-FI</u>

Transport-related items

In pratica?

PLAIN
AND
SIMPLE

Applicazioni, laboratori, visite, esperimenti

- ▣ Esperimenti e modellazioni con prototipi brevettuali NDT.
- ▣ Strumentazioni / sistemi per il monitoraggio: sperimentazioni e modellazioni.
- ▣ Esperimenti (su solidi fessurati e non) con sollecitazioni impulsive

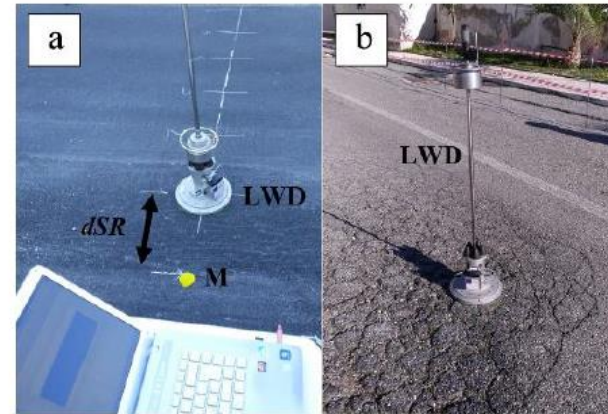


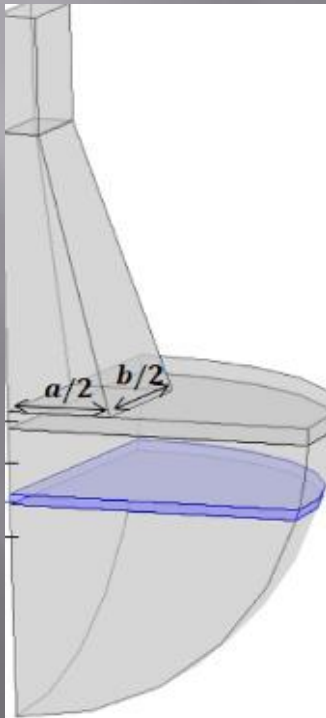
Figure 3. Determination of elastic moduli and acoustic responses of un-cracked, UC (a), and cracked, C (b), road pavement, at distances dSR (Source: LWD; Receiver: Microphone, M; yellow spot: modeling clay to fix M)

In pratica?

PLAIN
AND
SIMPLE

Applicazioni, laboratori, visite, esperimenti

- ❑ Esperimenti e modellazioni con prototipi brevettuali NDT.
- ❑ Strumentazioni / sistemi per il monitoraggio: sperimentazioni e modellazioni.
- ❑ Esperimenti (su solidi fessurati e non) con sollecitazioni impulsive
- ❑ Induction heating: Modellazioni multiphysics di sistemi per induction heating

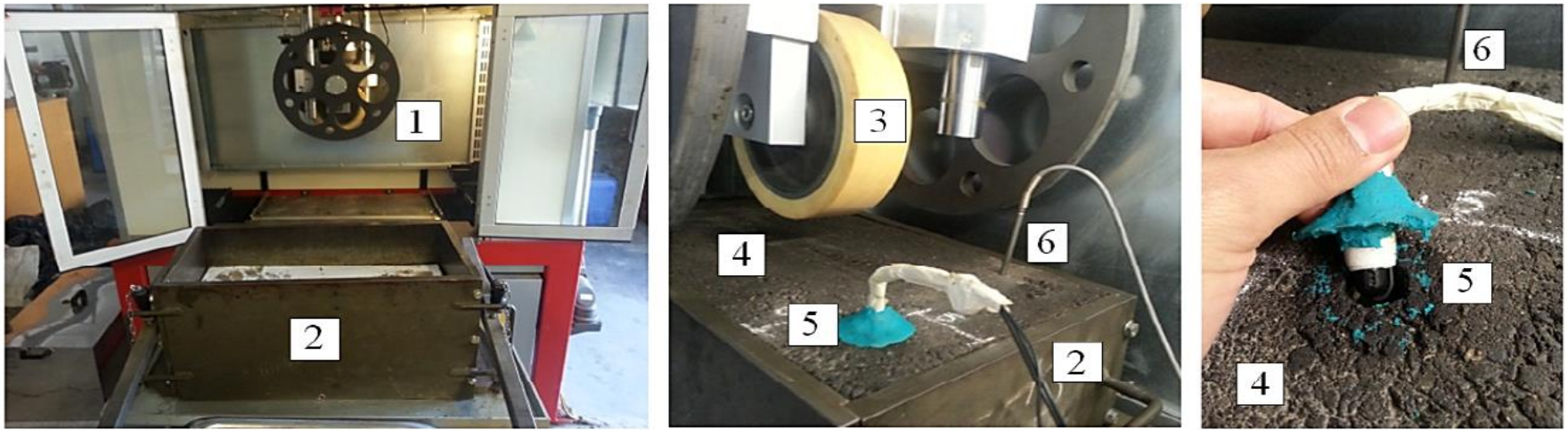


In pratica?

PLAIN
AND
SIMPLE

Applicazioni, laboratori, visite, esperimenti

- ▣ Esperimenti e modellazioni con prototipi brevettuali NDT.
- ▣ Strumentazioni / sistemi per il monitoraggio: sperimentazioni e modellazioni.
- ▣ Esperimenti su solidi fessurati e non con sollecitazioni impulsive



LEGEND: 1. The test chamber of the machine used during the in-lab tests. 2. The metallic housing that hold the slabs during the tests. 3. Rubber wheel. 4. One out of the three slabs under investigation. 5. The microphone used to detect the acoustic signals during the tests, placed in the hole drilled in the slabs and held in place by modelling clay. 6. One out of the two thermocouples set into a hole drilled in the slabs, and used to measure the temperature of the slabs during the tests.

Fig. 2. Experimental set up, comprised of Wheel Tracking Machine, microphone, and dense graded friction course slab.

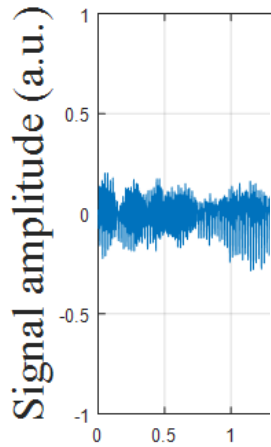
In pratica?

PLAIN
AND
SIMPLE

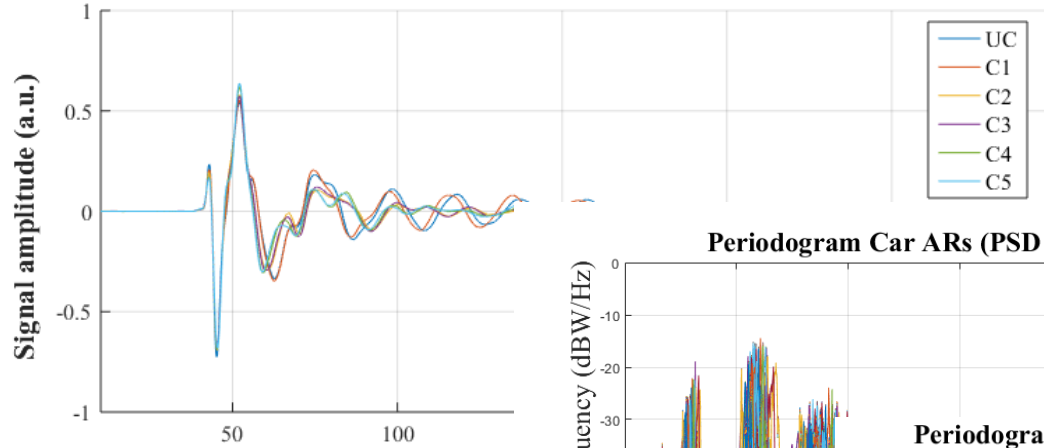
Applicazioni, laboratori, visite, esperimenti

- ▣ Analisi del segnale e derivazione informazione

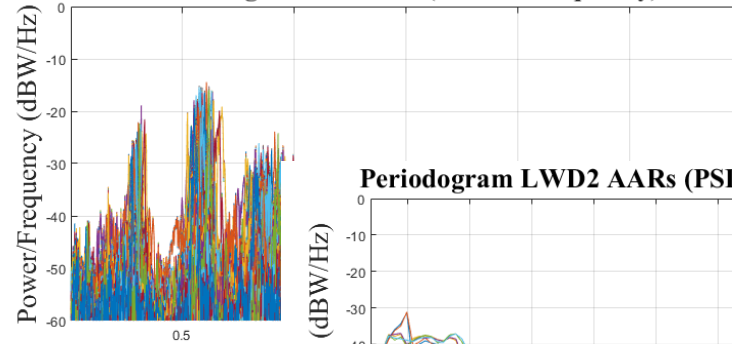
SHS0 -AR#1



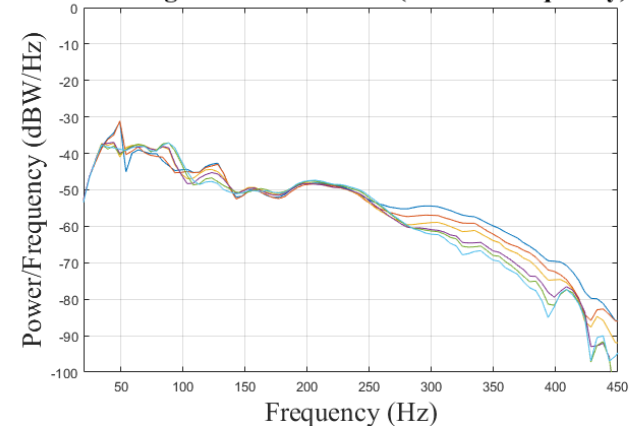
ARs in the Time domain



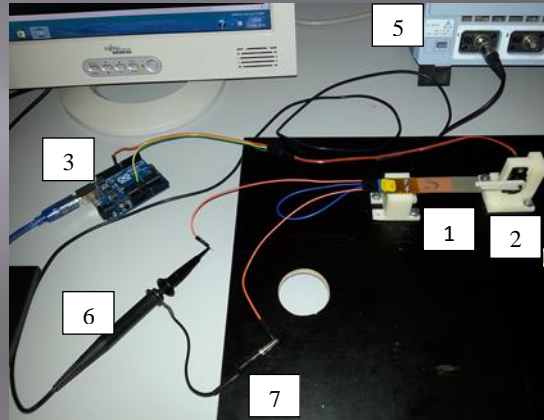
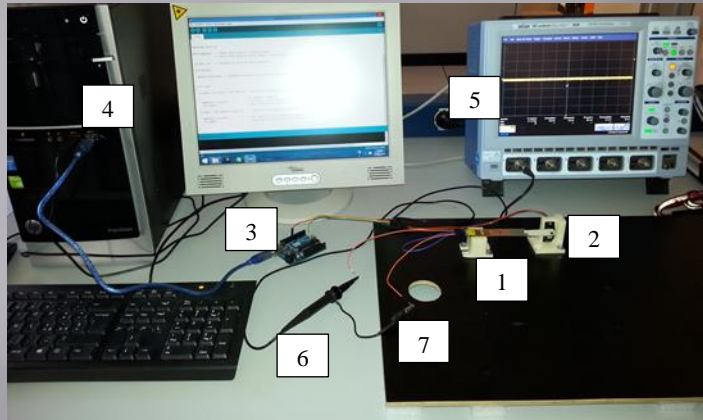
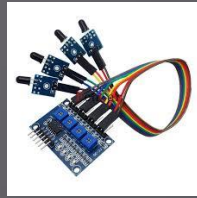
Periodogram Car ARs (PSD vs. frequency)



Periodogram LWD2 AARs (PSD vs. frequency)



In pratica?



Sistema di prova (collegato in serie), 1= Harvester, 2= Servomotore; 3= Piattaforma elettronica "Arduino"; 4= PC/Alimentazione servomotore(USB); 5 = Oscilloscopio; 6= Sondino con pinza retrattile; 7=Pinza a coccodrillo per massa; 8= Schermo PC che mostra l'interfaccia grafica del software Arduino installato in 4.

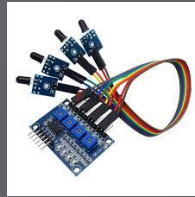
Smart road technologies and performance



Prof. Filippo G. Praticò

keywords

Integrated Smart Sensing System



Remote Processing Unit

Sensors

Traffic signal preemption?

Transducers

Road surface and weather informati

Geophones

Miniature sensor

load cells

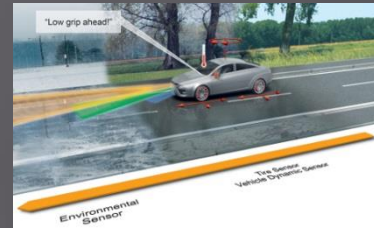
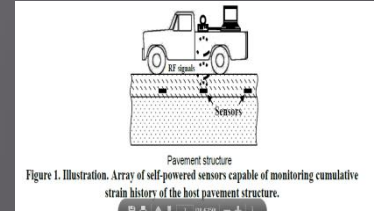
Remote Processing Unit

a wireless integrated circuit sensor .

2) a piezoelectric transducer.

3) a RF reader.

rain gauge (also known as an udometer, pluviometer, or an ombrometer)

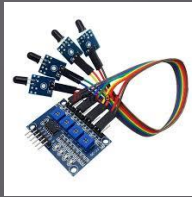


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Imprese?? Lavoro??-Prospettive pratiche??



ANAS (<http://www.stradeanas.it/>) - Trenitalia - RFI

TE CONNECTIVITY ([HTTP://WWW.TE.COM/USA-EN/ABOUT-TE/OUR-COMPANY.HTML](http://www.te.com/usa-en/about-te/our-company.html))

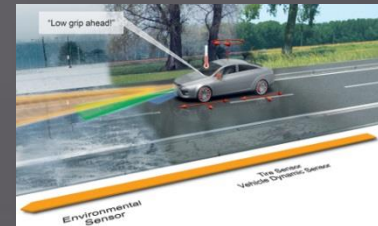
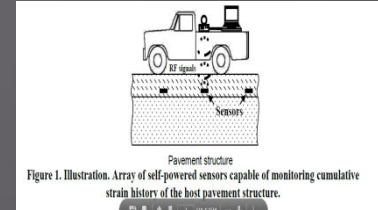
Vaisala

(<http://www.vaisala.com/en/roads/products/roadweathersensors/Pages/default.aspx>)

Lufft Mess- und Regeltechnik GmbH

(<http://www.lufft.com/en/company/>)

Road and traffic technology I (<http://www.roadtraffic-technology.com/mediapacks/online/about-us-online.html>)



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