INRiM Activities in AUV

Status Report for the 10th Meeting of CCAUV

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Prepared by Claudio Guglielmone, Giovanni Durando and Alessandro Schiavi

INRiM is active in Sound in air, Ultrasound and Vibration.

Due to a reorganisation of INRiM structure, Sound in Air and Vibration depends from STALT ("Servizio Tecnico per le Attività rivolte ai Laboratori di Taratura") and Ultrasound from "Qualità della Vita" division, in which researchers working in physical acoustic also operate.

Sound in water in Italy is an activity carried out by IDAC of CNR (National Research Council), whose application to become a DI for Italy is still in progress.

Sound in air.

INRiM is responsible for the national standards of acoustical pressure and provides traceability to 18 calibration laboratories in the Italian Accredia accreditation scheme. INRiM declares 23 CMCs for Sound in air, one for Reference Sound Sources power calibration.

INRiM participated in the CCAUV.AUV.A-K5 comparison on Pressure Calibration of LS1p microphones and is one of the linking laboratories in the following EURAMET.AUV.A-5 supplementary comparison, now in its completion stage, and participates in the EURAMET.AUV.A-S2 on free field comparison calibration of measurement microphones.

INRiM is participating in the SIB 56 "SoundPwr" EMRP research project that aims at establishing a new standard for sound power and improve the uncertainty of sound sources calibration. INRiM developed 2 primary power sources, one for the 100 Hz to 2 kHz frequency range and one for the 1-10 kHz frequency range. Agreement with conventional measurement is of the order of 0,5 dB, except at narrow frequency bands where emission form the mounting support is maximum due to mode resonances.

Building Acoustics measurement capabilities and facilities include standard test rooms for aerial and impact sound transmission loss measurement according to ISO standard, and extension to lower frequency range is active as a research experiment, and it is planned to establish a regular measurement service.

Activity in the sound emission quality evaluation of turbo_molecular vacuum pumps goes on and its findings have been beneficial for product development.

Ultrasound

INRiM is responsible for the national standards of ultrasound power. INRiM declares 2 CMC for US in the ultrasound power service.

INRiM participated in the CCAUV.AUV.A-K3.1 comparison on ultrasound power. The goal of the key comparison was to show the capabilities of the participating laboratories to determine the acoustic radiation conductance of an ultrasonic transducer by measuring the total time-averaged ultrasonic power emitted for an applied rms voltage in the nominal frequency range from 2 MHz to 16 MHz and for nominal output power values between 10 mW and 15 W.

INRiM participates in the HLT03-DUTy EMRP research project that aims at establishing a new standard for ultrasound dose. INRiM is responsible of WP4: Intercomparison of Method and was a pilot institute for the comparison. The NMIs involved were: Istituto Nazionale di Ricerca Metrologica (INRIM, Italy – the pilot institute), National Physical Laboratory (NPL, UK), Physikalisch-Technische Bundesanstalt (PTB, Germany) and Ulusal Metroloji Enstitüsü (TÜBİTAK-UME, Turkey).

INRiM work on study described here was to quantitatively assess thermal and mechanical effects of therapeutic ultrasound (US) by sonicating a joint-mimicking phantom, made of muscle-equivalent material, using clinical US equipment. In particular INRIM characterized the ultrasound field generated by seven different physiotherapy ultrasound equipment of the Department of Orthopaedics, Traumatology and Rehabilitation, CTO Hospital, Torino, Italy .

INRiM developed an ultrasound generator system, for in vitro sonodynamic treatment on HT-29 cell line, therefore a complete characterization of the ultrasound field in measurement conditions has been carried out .

Vibration and acceleration

INRiM is responsible for the national standard of acceleration.

INRiM provides traceability to two calibration laboratories dealing with accelerometer calibration. There are 17 CMCs in the field of vibration.

INRiM is one of the NMIs working in IND05 “MeproVisc” EMRP research project. A measurement apparatus and technical procedure for the determination of Dynamic Young’s Modulus of polymeric materials has been designed and realized.

Vibrations measurement capabilities and facilities include standard test for mechanical properties of materials (dynamic stiffness, damping, elastic modulus).

Among the support to industry, a study has been carried out to characterize peculiar devices (equipped with tri-axial accelerometer and inclinometer) used in rehabilitation medicine (MIUR Minister Project: TorinoWireless, Project n. DM49702).

2-days course on “Dynamic Acceleration” has been organized and held at INRiM in April 2014.

Publications:

Journals:

Lioce E E, Novello M, Durando G, Bistolfi A, Actis M V, Massazza G, Magnetto C, Guiot C. Therapeutic ultrasound in physical medicine and rehabilitation: characterization and assessment of its physical effects on joint-mimicking phantoms, 2014 ULTRASOUND IN MEDICINE AND BIOLOGY, vol. 40, p. 2743-2748, ISSN: 0301-5629, doi:10.1016/j.ultrasmedbio.2014.07.004

A. Schiavi, C. Guglielmone, F. Pennella, U. Morbiducci, "Acoustic method for permeability measurement of tissue engineering scaffold", Measurement Science & Technology 23 (10), 2012, doi:10.1088/0957-0233/23/10/105702.

F. Pennella, G. Cerino, D. Massai, D. Gallo, G. Falvo D'Urso Labate, A. Schiavi, M. A. Deriu, A. Audenino, U. Morbiducci, "A survey of methods for the evaluation of tissue engineering scaffold permeability", Annals of Biomedical Engineering, Vol. 41, No. 10, October 2013, pp. 2027–2041, DOI: 10.1007/s10439-013-0815-5;

P. Tarizzo, A. Formia, J. M. Tulliani, M. Zerbinatti, A. Schiavi, "A New Non Invasive Method To Evaluate The Detachments Of Plasters. First Results", International Journal of Conservation Science, Volume 4, Special Issue, 2013, Print ISSN: 2067-533X Online ISSN: 2067-8223.

A. Schiavi, A. Prato, A. Pavoni Belli, "The «dust spring effect» on the impact sound reduction measurement accuracy of floor coverings in laboratory", Applied Acoustics 97, October 2015, 115-120;

International conferences:

G. Durando, C. Guglielmone, J.Haller, O. Georg, A. Shaw, E. Martin, B. Karaböce. Towards Comparison of Ultrasound Dose Measurements - Current Capabilities and Open Challenges. 2015 Procedings of ICU2015, Physics Procedia 70, 1114-1118 (2015). DOI: 10.1016

Durando, G., Guglielmone, C., Actis, M.V., Massazza, G., Characterization of therapeutic ultrasound devices for rehabilitation and physical medicine, 2015 IEEE International Symposium on Medical Measurements and Applications, MeMeA 2015 - DOI: 10.1109/MeMeA.2015

A. Schiavi, A. Germak, F. Mazzoleni, D. Riva, "Metrological characterization of rocking boards and postural readers to assess single stance stability in human subjects", IMEKO 22nd TC3, 12th TC5 and 3rd TC22 International Conferences, Cape Town, Republic of South Africa, February, 3 – 5, 2014, Congress proceedings.

Laura Rossi, Claudio Guglielmone, and Alessandro Follo: *Quantification of perceived sound quality of turbo molecular pumps through psychoacoustics assessment.* Inter Noise 2013. Innsbruck 15-18 September 2013

P. Tarizzo, C. Guglielmone, A. Schiavi, M. Cerreti But, L. Zaretti, "Study on the use of plane wave tube as a base for a non destructive control instrument for frescoes damage assessment", AIA-DAGA 2013 Conference on Acoustics - Joint Conference of the 40th Italian (AIA) Annual Conference on Acoustics and the 39th German Annual Conference on Acoustics (DAGA), Merano (BZ), 18-21 March 2013, Atti del convegno;

A. Schiavi, L. Shtrepi, “Ergun-Wu Equation: A Novel Approach for the Determination of Physical Parameters in Low/Medium Porosity Materials”, AIA-DAGA 2013 Conference on Acoustics - Joint Conference of the 40th Italian (AIA) Annual Conference on Acoustics and the 39th German Annual Conference on Acoustics (DAGA), Merano (BZ), 18-21 March 2013, Atti del convegno;

E. Candelari, V. Serra, P. Tarizzo, A. Schiavi, F. Russo, “Acoustic Performance of a Green Modular System”, AIA-DAGA 2013 Conference on Acoustics - Joint Conference of the 40th Italian (AIA) Annual Conference on Acoustics and the 39th German Annual Conference on Acoustics (DAGA), Merano (BZ), 18-21 March 2013, Atti del convegno;

A. Prato, A. Schiavi, “Methods for the Determination of Laboratory Airborne Sound Insulation at Low Frequencies”, AIA-DAGA 2013 Conference on Acoustics - Joint Conference of the 40th Italian (AIA) Annual Conference on Acoustics and the 39th German Annual Conference on Acoustics (DAGA), Merano (BZ), 18-21 March 2013, Atti del convegno;

L. Rossi, A. Fardin, A. Schiavi, “Soft Metrology in acoustics: influence of noise on Stroop effect”, AIA-DAGA 2013 Conference on Acoustics - Joint Conference of the 40th Italian (AIA) Annual Conference on Acoustics and the 39th German Annual Conference on Acoustics (DAGA), Merano (BZ), 18-21 March 2013, Atti del convegno;

Pennella F., Gentile P., Deriu M.A., Gallo D., Schiavi A., Ciardelli G., Lorenz E., Hoekstra A.G., Audenino A., Morbiducci U, “A virtual test bench to study transport phenomena in 3D porous scaffolds using lattice Boltzmann simulations”, ASME 2013 Summer Bioengineering Conference (SBC2013), Sunriver, Oregon, USA., June 26-29;

P. Tarizzo, A. Formia, J. M. Tulliani, M. Zerbinatti, A. Schiavi, “A new non invasive method to evaluate the detachments of plasters. First results”, (Lecture), 1st International Conference on Innovation in Art Research and Technology, Hercules Laboratory - University of Evora (Portugal), 10th-13th of July 2013;

A. Prato, A. Schiavi, “Problems and possible solutions in the evaluation of laboratory airborne sound insulation at low frequencies”, Internoise2013, Innsbruck (Austria), September 15 - 18, Atti del convegno;

L. Rossi, A. Schiavi, “IPER index: quantification of influence of noise on human performance through physiological, operational and psychological parameters”, Internoise2013, Innsbruck (Austria), September 15 - 18, Atti del convegno;

R. Cuccaro, C. Musacchio, A. Schiavi, P. A. Giuliano Albo, A. Troia, S. Lago, “Physical characterisation of tissue mimicking materials by means of an ultrasonic method”, (Lecture), TEMPMEKO 2013, Madeira (Portugal), October 14 – 18, 2013;

A. Schiavi, A. Germak, F. Mazzoleni, D. Riva, “Metrological characterization of rocking boards and postural readers to assess single stance stability in human subjects”, IMEKO 22nd TC3, 12th TC5 and 3rd TC22 International Conferences, Cape Town, Republic of South Africa, February, 3 – 5, 2014, Atti del convegno.

L. Barbaresi, G. Semprini, A. Schiavi, “Acoustic performances of resilient layers for impact sound insulation in standard laboratory”, Forum Acusticum, Krakòw 7 -12 Settembre 2014, Atti del convegno;

G. Falvo D'Urso Labate, A. Schiavi, U. Morbiducci, R. Quarto, A. Audenino, G. Catalano, “Use of an acoustic method for the evaluation of scaffold transport properties in bone tissue engineering”, (Lecture), 41th Annual European Society for Artificial Organs (ESAO) Congress, 17-20 Settembre 2014, Roma.

A. Schiavi, L. Rossi, “Vibration perception in buildings: a survey. From the historical origins to the present day”, 6th International Building Physics Conference (IPBC), 14 – 17 June 2015, Torino, Atti del convegno.

A. Prato, A. Schiavi, “Sound insulation of building elements at low frequency: a modal approach”, 6th International Building Physics Conference (IPBC), 14 – 17 June 2015, Torino, Atti del convegno.

A. Astolfi, S. Carpinello, C. Pietrafesa, V. Serra, E. Valsesia, A. Griginis, A. Prato, A. Schiavi, V. De Astis, D. Zito, A. Cavalieri, “INTESA system: A new high-performance and highly integrated drywall façade”, 6th International Building Physics Conference (IPBC), 14 – 17 June 2015, Torino, Atti del convegno.

A. Schiavi, A. Prato, L. Barbaresi, G. Semprini, “The effect of damping in resilient materials used in floating floors on impact sound insulation”, 22nd International Congress of Sound and Vibration (ICSV), 12 - 16 July 2015, Firenze, Atti del convegno.

A. Prato, A. Ruatta, A. Schiavi, “Modal sound insulation in impact sound”, 22nd International Congress of Sound and Vibration (ICSV), 12 - 16 July 2015, Firenze, Atti del convegno.

A. Astolfi, S. Carpinello, C. Pietrafesa, E. Valsesia, A. Griginis, A. Prato, A. Schiavi, V. De Astis, D. Zito, A. Cavalieri, “Acoustical performances of an innovative dry-wall façade system with high thermal properties”, 22nd International Congress of Sound and Vibration (ICSV), 12 - 16 July 2015, Firenze, Atti del convegno.

A. Troia, R. Cuccaro, A. Schiavi, “Novel preparations for homogeneous tissue mimicking materials in hifu dosimetry study”, 22nd International Congress of Sound and Vibration (ICSV), 12 - 16 July 2015, Firenze, Atti del convegno.

A. Troia, R. Cuccaro, A. Schiavi, “New formulations for realization and characterization of homogeneous tissue mimicking materials for HIFU exposures”, MEMEA - 10th annual IEEE International Symposium on Medical Measurements and Applications, May 07-09, 2015, Torino, Atti del convegno.

A. Schiavi, A. Germak, F. Mazzoleni, “Simultaneous 3-axis mems accelerometer primary calibration: description of the test-rig and measurements”, IMEKO – XXI World Congress, 30 August – 4 September 2015, Prague, Atti del convegno.