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Subject of Research & Innovation

National Pingtung University of Science and Technology Office of Research and Development

Bioresources and Energy Technology Lab - Integration of engineering technologies into bioresources utilization

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1. Background

(a) Status of energy and environment in Taiwan

- High dependence on energy import: The dependence on imported energy is on the increasing trend from 95.84% in 1990 to 99.34% in 2008. On the other hand, the energy supply and energy consumption totaled 142.5 and 117.7 million kiloliters of oil e-quivalent (KLOE) in 2008, respectively, in contrast to 58.7 and 51.9 million KLOE in 1990, respectively.
- Increase in the total of carbon dioxide (CO2) emissions: The CO2 emission in 2008 was 256.97 million metric tons in contrast to 110.50 million metric tons in 1990. On average, annual growth rate was 4.80% from 1990 to 2008, which could be divided into two growth stages: 6.85% from 1990 to 2001, and 2.30% from 2001 to 2008.
- According to the Renewable Energy Development Act passed by the Taiwan's Cabinet (Executive Yuan) in June 2009, the biomass energy is defined below: the energy is generated from the direct utilization of agricultural & forestry plants, biogas and domestic organic wastes, or it is obtained by the treatment/processing of these bioresources. The green energy provides the multi-benefits, including energy security (low-carbon fuels), sustainable agriculture (biomass utilization), environmental protection (global change), and economic development (green industry).

(b) Status of agricultural residues (biomass) in Taiwan

- Agricultural enterprises generate general industrial wastes. The main examples of this type of orgaic wastes include food processing wastes, waste paper, organic sludges, scrap wood, sugar milling wastes, and so on. On the other hand, there are many common crops and fruits in Taiwan, including rice, corn (or maize), and coconut. Inevitably, large quantities of crop/fruit residues are those left in the field after harvest to provide fertilizing benefits for the next cropping cycle, or produced from the crop grain processing facilities (e.g., rice husk from rice-milling works). According to the national statistical data surveyed by the Environmental Protection Administration (EPA) and the Council of Agriculture (COA), the annual production of agricultural wastes/residues and organic industrial wastes was estimated to be over 5 million metric tons.
- Only small fraction of the crop residues (i.e., rich straw, rice husk, corn cob) generated in Taiwan were used for poultry feed, or reused as fuel for household cooking and made as paving materials in the animal husbandry. It should be noted that sugar milling wastes (i.e., sugar bagasse) were almost reused as auxiliary fuel in the boiler to generate the power (steam and/or electricity). However, most of crop/fruit residues were arbitrarily incorporated into the soil and burned in the open field. These waste management approaches have received much attention in recent years mainly due to the local air quality deterioration, the risk of road accidents caused by drifting smoke and the dissipation of bioenergy potential.

It is well known that agricultural crop residues contain high amounts of lignocellulosic materials (i.e., cellulose, hemicellulose and lignin) and possess high heating value on a dry weight basis. Therefore, they could be recognized as potential sources of biofuels and biopower based on multiple benefits of energy recovery, agricultural waste management and greenhouse gases (GHGs) emission reduction. Based on the background described above, the National Pingtung University of Science and Technology (NPUST) established the Graduate Institute of Bioresources (GIB; Ph. D. program) in 2004 under the College of Agriculture. One of the main development goals in the GIB is to utilize the biomass residues. Under the funding support by the Ministry of Education, the College of Agriculture further set up the Asian Pacific Research Center for Tropical Agriculture (APRCTA) in 2008. One of the core laboratories is the Bioresources and Energy Technology Lab, which aims at creating added-values and industrial sustainability from the utilization/recycling/reuse of bioresources and biomass residues as biomass energy and green materials.

2. Goals

- Combining the resources of the APRCTA to develop the key technologies of ecological (bio-based) materials and bimass energy.
- Integrating the campus resources regarding agricultural and engineering technologies to promote the research & development on the utilization of agricultural residues, organic scraps, or by-products and other bioresources.
- Connecting the nearby official research organizations and industrial enterprises to establish the collaborative platform for human power training, examination & analysis, and technology development.

3.Research & development Features

Orientations	Main planning contents	Topics, Supports and Goals
Technology development	**Developing bioresources & ecological materials**	**Carbon materials, biochar, energy crops, biosludge, shell residues**
	Developing thermal conversion technologies	**Biodiesel, pyrolysis, carbonization, liquefaction,**
	Developing examination analysis technologies	**Analytical techniques of biofuels and carbon materials**

Orientations	Main planning contents	Topics, Supports and Goals
Teaching & eduation	**Supporting professional course program**	**Biomass energy program (Dept. of Biomechatronics Eng.)**
	Supporting professional courses (Graduate)	**Grad. Inst. of Bioresources**
	Supporting professional courses (Undergraduate)	**Dept. of Wood Sci. & Design, Center for General Education**
Academia-industry performance	**Publishing research and applied papers**	**3-5 SCI papers per year**
	Establishing platform for industrial technologies	**1-2 academia-industry project per year**
	Establishing platform for examination & analysis	**Examination & analysis for biodiesel, carbon materials, biomass characterization**

4. Lab space

(a) General & analytical lab（Room No.： BT 310； Area： 140 m2， including general lab 90 m2 and analytical lab 50 m2）

(b) Thermal conversion lab（Room No.：BT 305；Area：40 m2）

5. Research facilities

Pycnometer
(Model No: AccuPyc 1330: Micromeritics Co., USA)

Planetary ball mill
(Model No: PM 100; Retsch Co., Germany)

Surface area & porosity analyzer
(Model No: ASAP 2020; Micromeritics Co., USA)

Viscometer
(Model No: TV 2000-AKV; Tamson Co., Netherland)

6. Selected research papers

About 50 research papers (including in-press papers) have been published since 2005. Some important and relevant papers were listed below:

Tsai, W.T.*, Chang, J.H., Hsien, K.J., Chang, Y.M. (2009), Production of pyrolytic liquids from industrial sewage sludges in an induction-heating reactor. Bioresource Technology, 100, 406-412. (SCI; Impact factor = 4.453)

Tsai, W.T.*, Chang, J.H., Hsien, K.J., Chang, Y.M. (2009), Production of pyrolytic liquids from industrial sewage sludges in an induction-heating reactor. Bioresource Technology, 100, 406-412. (SCI; Impact factor = 4.453)

Tsai, W.T.*, Lee, M.K., Chang, J.H., Su, T.Y., Chang, Y.M. (2009), Characterization of bio-oil from induction-heating pyrolysis of food-processing sewage sludges using chromatographic analysis. Bioresource Technology, 100, 2650-2654. (SCI; Impact factor = 4.453)

Tsai, W.T.*, Lin, C.I. (2009), Overview analysis of bioenergy from livestock manure management in Taiwan. Renewable & Sustainable Energy Reviews, 13, 2682-2688. (SCI; Impact factor = 4.075)

Tsai, W.T.* , Hsien, K.J., Hsu, H.C., Su, T. Y., Lin, K.Y., Lin, C.M. (2008), Utilization of ground eggshell waste as an adsorbent for the removal of dyes from aqueous solution. Bioresource Technology, 99, 1623-1629. (SCI; Impact factor = 4.453)

Tsai, W.T.* , Mi, H.H, Chang, J.H., Chang, Y.M. (2009), Levels of polycyclic aromatic hydrocarbons in the bio-oils from induction-heating pyrolysis of food-processing sewage sludges. Journal of Analytical and Applied Pyrolysis, 86 (2), 364-368 (SCI; Impact factor = 1.911)

Tsai, W.T.*, Yang, J.M., Hsu, H.C., Lin K. Y., Chiu, C.S., Chiu, C.H. (2008), Development and characterization of mesoporosity in eggshell ground by planetary ball milling. Microporous & Mesoporous Materials, 111, 379-386 (SCI; Impact Factor = 2.555)

Tsai, W.T.*, Lan, H.F., Lin, D.T.(2008), An analysis of bioethanol utilized as renewable energy in the transportation sector in Taiwan. Renewable & Sustainable Energy Reviews, 12, 1364-1382 (SCI; Impact factor = 4.075)

Tsai, W.T.* , Mi, H.H, Chang, Y.M., Yang, S.Y., Chang, J.H. (2007), Polycyclic aromatic hydrocarbons (PAHs) in bio-crudes from induction-heating pyrolysis of biomass wastes. Bioresource Technology, 98, 1133-1137. (SCI; Impact factor = 4.453)

Tsai, W.T.*, M. K. Lee, Y. M. Chang (2007), Fast pyrolysis of rice husk: product yields and compositions. Bioresource Technology, 98, 22-28. (SCI; Impact factor = 4.453) ♦

The Animal Vaccine & Adjuvant Research Center(AVARC)

Chun-Yen Chu, Graduate Institute of Animal Vaccine Technology
http://tve.npust.edu.tw:8080/College/AgriCulture/vaccine.htm

1.Introduction

1.1 Objectives

The Animal Vaccine & Adjuvant Research Center （AVARC） was founded in 2003 by the Ministry of Education and National Pingtung University of Science and Technology (NPUST), aiming to developing new technologies, fostering research and development personnel, and enhancing the research capability on animal vaccines and adjuvants of NPUST. In addition, apply biotechnologies to fulfill the demands from the industry. Thus, the goal "Industrial technology, technological industrialization" can be achieved.

1.2 Features

1.2.1 The First and Unique Animal Vaccine & Adjuvant Research Center of Taiwan.

1.2.2 The First and Unique Graduate Institute of Animal Vaccine Technology.

1.2.3 Affiliation with The Animal Laboratory of Animal Disease Diagnostic Center in the Southern District.

1.2.4 Equipped with an Animal Vaccine Pilot.

1.3 Services

1.3.1 Core Laboratory：Microfluidizer、Ultra-Centrifuge、Light Cycler、Particle Size Analysis、Immuinescence Fluorescence Imaging System、Freeze Dryer.

1.3.2 Isolated Breeding Systems of Aquatic Species.

1.3.3 Isolated Feeding System for Swine And Chicken.

1.3.4 Animal Vaccine Pilot.

1.3.5 Evaluation of Immuno-Modulatory Effects、Safety Evaluation、Evaluation on Hepatoprotection、Evaluation of Antioxidative Activity.

2.Achievements

2.1 Obtained 5 Patents

2.1.1 Anti-Hypersensitive Inflammation and Anti-Allergic Activities of Zingiber Zerumbet (L.) Smith. (Invention No. Ⅰ82281)

2.1.2 Methodology for Obtaining Porcine Bone Marrow Haematopoietic Cells Used for Dendritic Cells in Vitro Differentiation. (Invention No. Ⅰ272307)

2.1.3 Structure Improvement of Animal Isolator. (Invention No. Ⅰ268757)

2.1.4 Structure Improvement of Animal Isolator System. (Invention No. Ⅰ284505)

2.1.5 Movable Multi-Purpose Isolation Facility with Negative Pressure Ventilation. (Invention No. Ⅰ248810)

2.2 Completion of Eight Cases of Technology Transfer

2.2.1 Porcine Clostridium Toxoid Vaccine.
KAOHSIUNG BIOLOGICAL PRODUCT CO., LTD

2.2.2 Porcine Reproductive and Respiratory Syndrome Virus Subunit Vaccine.
FORMOSA BIOMEDICAL INC.

2.2.3 Porcine Circovirus Type 2 Subunit Vaccine.
FORMOSA BIOMEDICAL INC.

2.2.4 Method for Obtaining Porcine Bone Marrow Haematopoietic Cells Used for Dendritic Cells in Vitro Differentiation.
KAISER PHARMACEUTICAL CO., LTD.

2.2.5 An in Vitro Screening System for
KUANG CHUAN BIOTECH CO., LTD.

2.2.6 Development of Sterptococcus Suis Inactivated Vaccine (I)(II).
CHIEN YING CO., LTD.

2.2.7 An in Vitro Screening System of Avian Immune Cells for Detection of Biological Activities of Immunomodulators.
KING'S CROWN NUTRITION TECHNOLOGY CO., LTD.

2.2.8 Streptococcus suis Recombinat Subunit Vaccine.
CHIEN YING CO., LTD.

2.3 Patent in application

2.3.1 Chinese Hamster Ovary Cells with A Stable Expression of Porcine Granulocyte/Macro-phage Colony-Stimu -lating Factor.

2.3.2 CpG DNA Adjuvant in Avian Vaccines.

2.3.3 A Competitive Receptor Binding Assay for Detecting Beta-Glucans Having Immunomodulatory Activity to Human Cells.

2.3.4 Stable Clone Of Chinese Hamster Ovary Can Stably Express Chicken Interleukin-18.

2.3.5 Bioactive Liposomes and M- ethod for Making the Same.

2.3.6 In Vivo Quantitative Method of Soluble β-Glucans By Using Transformant of Surface Expression Vector Carrying Gene of Receptor Fusion Protein.

2.3.7 Mannheimia Haemolytica Recombinant Membrane Proteins Vaccine.

2.3.8 A Competitive Binding Assay for Detecting Soluble β-Glucans Using Cell Surface Display System of Carbohydrate Recognition Domain of Human Dectin-1.

2.3.9 To Develop the Chlamydophila Abortus Diagnostic Kit.

3.Faculty

Research Group	Name
Adjuvant	**Hso-Chi Chaung**, Mei-Li Wu,Chi-I Chang,Jai-Wei Lee, Kuo Pin Chuang
Poultry vaccine	**Yi-Yang Lien**, Hung-Jen Liu, Maw-Yeong Lin
Aquatic vaccine	**Shih-Chu Chen**, Shinn-Shyong Tsai, Chung-Da Yang
Swine vaccine	**Wen-Bin Chung**, Ming-Huei Liao, Ming-Tang Chiou
Ruminant vaccine	**Chun-Yen Chu**, Shyh-Shyan Liu, Tsung-Chou Chang

4. Animal Vaccine Pilot facilities and activities

web:http://tve.npust.edu.tw:8080/College/AgriCulture/vaccine.htm
Tel:08-7703202-5076 Dr. Shih-Chu Chen
E-mail：scchen@mail.npust.edu.tw


Teaching Practice Courses


Visitors from the domestic industry


10 L fermentor

Vibration and Acoustics Laboratory

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I. Introduction

Mechanical vibration is an important issue for mechanical fatigue failure, machinery precision, and manufacturing process. The mechanical design in domestic industry is still in structural static analysis or even just for simple mechanics calculation and neglecting the importance of dynamic analysis. On the other hand, the industrial noise problem becomes important for environmental concerns. The industry in Taiwan just notices the noise issue and yet lack of complete study in noise generation and propagation analysis so as to carry out proper action in noise protection. In fact, noise and vibration are strongly related to each other and important issues to deal with. The diagnosis and control of mechanical vibration and noise are urgent and crucial for industry.

Vibration and Acoustics Laboratory (VAL) in the Department of Mechanical Engineering, NPUST is founded in 1993 and plans the development objectives as follows:

1. Dedicate to the education of sound and vibration technology for specialization, popularization and generalization.
2. Dedicate to the training of students to enhance the professional skills in sound and vibration and enable to perform practical applications and lifelong learning
3. Dedicate to the technology development in the field of sound and vibration for the application in industry and academic research

The technical services of VAL include:

1. Structural vibration modal testing and finite element analysis for products and machineries
2. Noise and Vibration measurement, analysis and improvement for products and machineries
3. Finite element analysis (FEA) in structural static, heat transfer and vibration analysis
4. Training program in Computer Aided Engineering (CAE)
5. Training programs in vibration, noise and Experimental Modal Analysis (EMA)

This article introduces the VAL team about the research projects in recent years, the integration of technology in noise and vibration, and the performance for industrial service.

II.Research Activity and Performance in VAL

The core technology in VAL includes:

1. Vibration analysis: fundamental principle of vibration, vibration characteristics of structures, vibration standards and regulations, analytical procedure in solving vibration problem, mathematical modeling techniques, four types of vibration analyses (modal, harmonic, transient and spectrum response analyses), and application to engineering problems.
2. Noise measurement analysis: fundamental principle of sound, sound wave theory, sound spectrum and 1/3 octave band analysis, sound evaluation indices, measurement standards, sound level meter and FFT analyzer, and applications to engineering structural sound measurement.
3. Experimental Modal Analysis (EMA): experimental measurement of vibration, instrument implementation (FFT analyzer, accelerometer, and impact hammer), signal processing techniques, procedure in performing EMA, and engineering applications.
4. Computer Aided Engineering (CAE): applications of FEA software (ANSYS, LS-DYNA, VL-ACOUSTICS) in practical engineering problems, fundamentals of FEA, procedures in FEA application, various types of structural FEA (truss, beam, plane, solid, shell and contact elements), topics in statics, heat transfer and vibration.

The research ability and integration technology development in the VAL contain two main themes:

1. Integration of CAE and EMA for Engineering Design and Applications

2. Development and Application of Low -Cost and Customized Vibration and Noise Measurement and Automated Analysis System

2-1 Integration of CAE and EMA for Engineering Design and Applications

The idea and technology for the integration of CAE and EMA in virtual testing have been widely adopted in practical engineering problems. This technology in Taiwan is still in the infant stage and for future development.

CAE can be interpreted as the use of computer programs developed by oneself or commercial software to conduct engineering analysis. The most popular numerical tools should be the finite element method (FEM). The use of FEM in performing analysis for engineering problems is called FEA. Since most practical engineering structures are complex, the industry generally uses the general purpose FEA software. The VAL mainly adopts the ANSYS software in teaching and research.

EMA in simple words is just the experimental methods for vibration measurement. The purpose of EMA is to obtain structural modal parameters, including natural frequencies, mode shapes, and modal damping ratios. The applications of EMA include: (1) model verification, (2) response prediction, (3) model modification (4) force determination, (5) sub-structuring and coupled analysis, and (6) health monitoring or damage detection. Figure 1 shows the flow chart for model verification via the integration of EMA and FEA. The objective in performing model verification is to obtain validated analytical model. Figure 2 reveals the flow chart in structural design modification. The first step is to conduct model verification to validate the analytical model. The next step is to perform response prediction via the validated model. Finally, if the structural modification is required in order to meet the design specification, the model modification will be carried out and repeated to achieve the design goal.

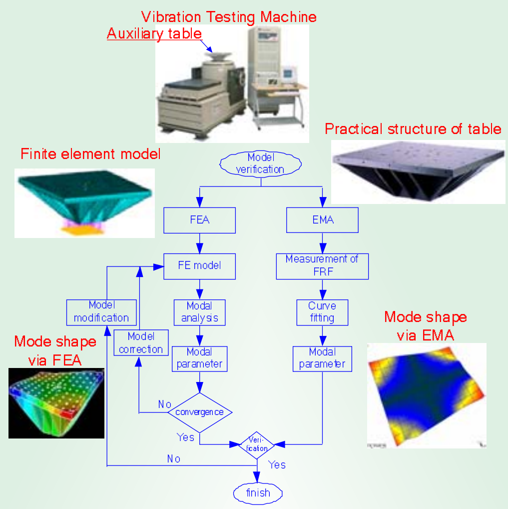


Figure 1 Model verification flow chart by integrating EMA and CAE techniques

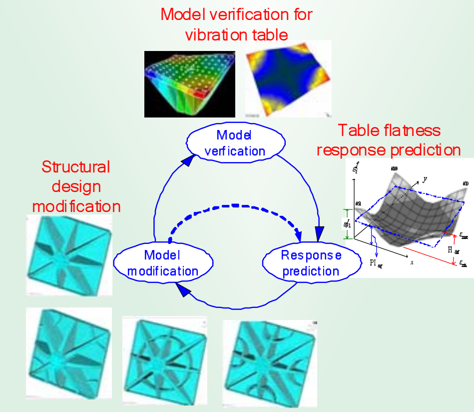


Figure 2 Structural design modification flow chart for CAE and EMA

The research topics in coop with industry by applying the integrated technology of CAE and EMA conducted by the VAL in recent years include the followings:

1. The integration of design and development of golf clubs (OTA Co.)
2. The Design analysis of vertical auxiliary table of vibration testing machine (King Design Co.)
3. The integration of design and development of sliding table of shock testing machine (King Design Co.)
4. The analysis and experimental verification of environmental vibration testing of printed circuit board (ASE Group)
5. The design and development of components in vehicle industry (MIRDC)
6. The development and application of intelligent material structural system (NSC)
7. The design analysis of percussion musical instruments (NSC)

The VAL has started the coop work with OTA Co. since 1999 and dedicated to the design analysis technology development and procedures for over 10 years. The major achievement includes 6 funded research projects, 27 academic papers, and 8 graduate and 19 undergraduate students involved in the research activities. The established technology contains: (1) the application of CAE to vibration and impact analysis of golf clubs, (2) the inter-connection between CAD (Pro Engineer) and CAE (ANSYS) software for analysis, (3) the application of EMA to experimental verification for golf clubs, (4) the integration of CAE and EMA for model verification to obtain the validated analytical model, (5) introducing the virtual testing design concept for golf club design modification with particular purposes of performance specification, and (6) the prediction of hitting sound of golf club and the structural design of golf club head.

King Design Co. is a manufacturer for the vibration and shock testing machines and coop with the VAL since 2003. The King Design Co. Reliability Lab is working with the VAL. There are 7 funded research projects from NSC and 28 academic conference and journal papers. 7 gradate and 6 undergraduate students participated in research work. The well established technology in the design analysis and development is mainly for the vertical auxiliary table (vibration table) and sliding table (shock table) including: (1) introducing the CAE and EMA techniques to the structural vibration characteristic study for the design of vibration and shock tables, (2) establishing the model verification and virtual testing technique to integrated design, (3) developing the standard design verification procedures for the tables to fit the need of different vibration and shock testing specification required by the customers.With the use of CAE and EMA techniques and the professional analytical abilities in shock and vibration, the integrated design concept and procedure can also be adopted to the development of other precision machineries.

ASE Group is a known IC packing company. The VAL applies the special skills of EMA as well as the model verification procedure as shown in Figure 1 to enhance the design analysis with the verification of experimental works. The coop work has lasted for 5 years since 2005. The company provides the scholarship for a graduate student annually. There are 17 academic papers published. Figure 3 reveals the vibration testing and analysis verification of PCB. So, the stress distributions of package, IC and solder balls can be predicted as shown in Figure 4. The VAL leads the industry in this field for coupling effect evaluation including thermal and random vibration loading simultaneously.

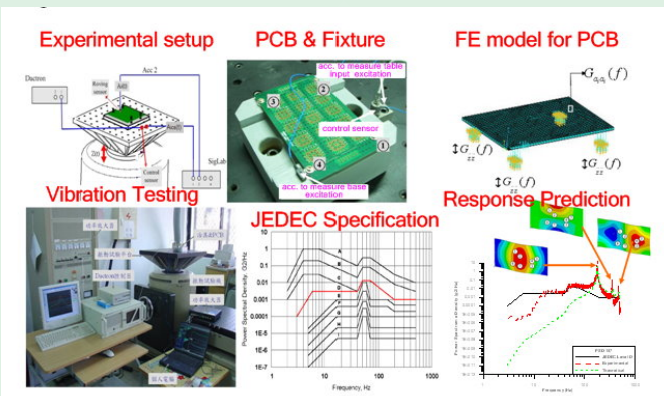


Figure 3 Vibration testing and analysis verification for PCB

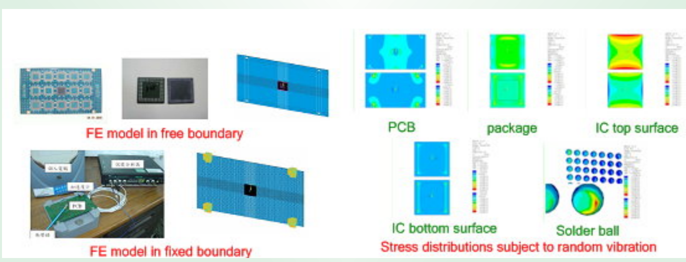


Figure 4 Vibration testing and stress analysis for PCB, package, IC and solder ball

The integrated CAE and EMA techniques have been widely adopted for practical application. Beside the aforementioned about the golf club design, other sport equipments such as tennis rockets are also investigated. The technique has been used for 3C products and testing machine design for environmental shock and vibration tests. Other industries such as precision machineries for machine tools or automobiles can be well related to the CAE and EMA integrated technology. The VAL has carried out many engineering projects associated with industries..

The VAL plays the role in supporting the industrial needs and academic contribution. The objective of VAL will continue to train students with the integrated technology of CAE and EMA as well as the applications to engineering problems and educate students with positive working attitude for the industry.

2-2 Development and Application of Low-Cost and Customized Vibration and Noise Measurement and Automated Analysis System

Vibration is an important issue in industry. Machineries become higher speed and more precision and thus require more abilities to reduce vibration effect. However, the vibration analysis technique in domestic industry is not so common. One of the reasons is that the observation and analysis of vibration phenomenon are not easy for the cost of testing equipment as well as the lack of analysis tools. To enhance the development in the field of vibration, the domestic language instruction media in teaching vibration is demanded and can be used for industrial applications.

The experimental measurement and analysis of sound and vibration generally rely on the general purpose FFT analyzer or Sound Lever Meter to obtain the acceleration and sound pressure level, and so forth the corresponding frequency domain analysis can be conducted to get sound and vibration spectra and to study the structural sound and vibration characteristics for machineries and products. For general applications, the experiments can be easily carried out. However, there are potential disadvantages, such as the high price for the well-equipped functional analyzer. For simple purpose applications such as the on-line inspection base on sound and vibration signals or for other post-processing applications, the analyzer may not be economic. Also, the data requiring necessary post processing is not always available or easy to transfer to other analysis programs.

For the industrial needs on the further applications of noise and vibration measurement and analysis, the VAL dedicates to develop noise and vibration analysis programs. The software will be developed base on the concept of copyleft for freeware deployment so as to promote the professional fields in sound and vibration and become popular. The low cost and customized measurement and analysis system will be established for different purposes and different industrial requirements. The recent coop works regarding to the development of analysis modules and measurement application modules by the VAL are illustrated as follows:

1. Development and verification of fan noise measurement system (Yen Sun Co.)
2. Development of fan sound quality inspection and automated quality control module (Yen Sun Co.)
3. Development of tool FRF measurement system and tool chatter stability diagram prediction module (Precision Machinery Center)
4. Development of vibration analysis soft -ware (NSC/AnCAD Co.)
5. Module for Modal analysis by free vibration response only (NSC)
6. Development of structural damage detection base vibration mode shape (NSC)
7. Sound simulation generator and spectrum analysis module (NSC)
8. Measurement and evaluation of bus interior sound and vibration (Master Co.)
9. Golf club vibration quality index analysis module (OTA Co.)
10. Sound and vibration correlation analysis module for golf club and club

head (OTA Co.)

11. Golf club hitting sound prediction module (OTA Co.)
12. Pad design analysis module for shock testing machine (King Design Co.)

The sound quality inspection for small fan in production line is of interest. The VAL uses the microphone to measure the sound pressure level of fans in conjunction with A/D card with the MATLAB platform. Figure 5 reveals the measurement module for fan noise inspection and will be extended to automatic quality control system for product on-line measurement. The customized measurement and analysis modules are useful for industrial applications.

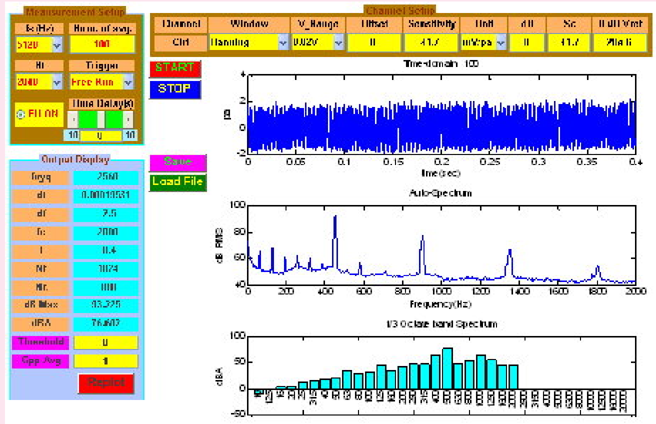
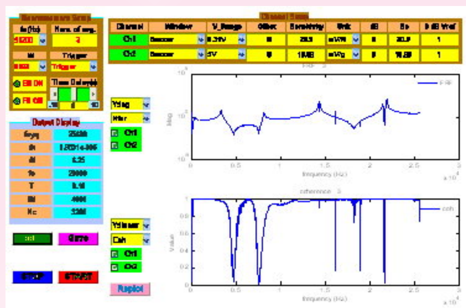
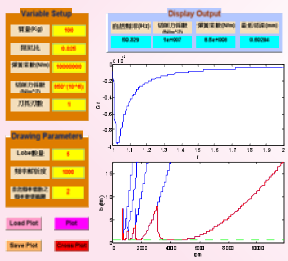


Figure 5 Fan noise measurement graphic user interface

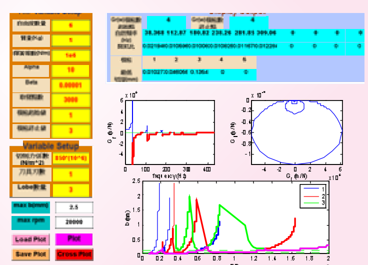
Chatter of machine tools is a kind of self-excited vibration and generally occurred in machining. The chatter is the major defect for cutting vibration to affect the machining quality and efficiency. Chatter will also cause bad effects on machining surface, surface roughness and noise as well as tool wears. The tool failures and the reduction of metal removal rate will increase the cost, time and material. The VAL use the MATLAB platform to develop the tool frequency response function measurement module as shown in Figure 6(a) and thus the tool chatter stability diagram can then be predicted as shown in Figures 6 (b) and (c) to provide a guided tool to determine the stability lobe diagram (SLD) so as to avoid chatter and increase the cutting efficiency.

6 (a) Dual channel FRF measurement module





6(b) SLD for SDOF model



6(c) SLD for MDOF model

Figure 6 Tool FRF measurement and chatter stability lobe diagram (SLD) prediction

For engineering problems related to sound and vibration either by experimental measurement or theoretical analysis, the post processing for the measured or analytical data is the crucial know-how and know-why issue. Different purposes of automatic analysis modules are generally required and can be provided for industrial uses.

The VAL develops the sound and vibration analysis and measurement system for particular purposes of applications. The features of the analysis tools are independent, interactive, user-friendly, graphic user interface (window), and with automatic data storage and retrieval functions. Besides, the low cost and customized sound and vibration analysis package can be useful for teaching and beneficial for industrial applications for different purpose needs.

III. Conclusions

The VAL has carried out many government and industrial funded research projects and established tight relationship with local industry to support high quality of engineering services. The VAL will continue to facilitate the equipment and fertilize students with sound and vibration professionals to meet the need for domestic industry and promote the extension education. The coop work with industries to create the professional values regarding to the fields in sound and vibration is always the goal. The VAL will certainly continue the works in (1) Integration of CAE and EMA for Engineering Design and Applications, and (2) Development and Application of Low-Cost and Customized Vibration and Noise Measurement and Automated Analysis System, and surely to promote and enhance the R&D and international competition abilities for industrial development in our country. ♦

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