QUARTERLY 2016 VOLUME 8 ISSUE 31

THE CHALLENGER

global quality and service system of metal working industry

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FAX:+86-21-5764-9076
http://www.sauter-group.com
E-mail:infocn@gptrading.net

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Publisher: Paul Chang | info@mail.buffalo.com.tw
Editor: Iris Chen | a15@mail.buffalo.com.tw
Editorial board: Paul Chang | Iris Chen | Kelly Chuang | Shin Huang
Layout and typesetting: Treasure Map Advertising Corp.
apchen.ap@msa.hinet.net

Subscription: Buffalo Machinery Co. Ltd.
56, Lane 318, Desheng Road, Daya District,
Taichung City 428-46, Taiwan
TEL: +886-4-25 60 37 59 | FAX: +886-4-25 60 37 69
www.buffalo.com.tw

MICROCUT THE CHALLENGER

Article contribution is welcome!

The Challenger welcome submission from all fields of machine tool industry related. The Challenger is committed to prompt evaluation and publication of submitted articles. Company profiles, production experience, feedback of using MICROCUT's products are the most valuable article to share with "The Challenger" readers. Please send the article and pictures (if any, images resolution in 300 dpi or above) to the local Challenger Factory Outlet or email to info@mail.buffalo.com.tw

Big Data Discussion

The term "Big Data" has been extensively discussed for decades with increasing use as a marketing tool in recent years. Big Data in regards to technology and its application in the metalworking machine tool industry was discoursed by the German Federal Ministry of Education and Research in association with Forschungsunion and National Academy of Science and Engineering, in order to secure the future of the German manufacturing industry, by launching the "Final Report of the Industrie 4.0 Working Group" of the "Recommendations for implementing the strategic initiative INDUSTRIE 4.0" in April 2013.

The third industrial revolution introduced electronics and IT to optimize automation. It replaced the original use of electric power by increasing quantities and streamlining production; thereby enabling mass production, lowering manufacturing costs and increasing competitiveness. Now, the Industrie 4.0 era is based on the Cyber-Physical Systems which involves merging the physical and virtual worlds and involves the philosophy of Total Quality Management (TQM) and machine reliability. This is achieved by integrating the information of suppliers and sales with the flexibility of production through digitization of materials and precisely controlling the status of production. Thus, the facilities of manufacturing can be efficiently utilized to the highest limit. The reliability of the manufacturing facilities is vital to ensure stability and continuous automate production. This will ensure the highest competitiveness and market share for the enterprise.

To activate the Cyber-Physical Systems and Total Quality Management for the production processes of machine tool facilities, at the beginning of Research and Development, the demands of application for the facilities should be taken into account. The "Mean Time between Failures, MTBF" should also be considered when designing the facilities. Concurrently, all the motion and related motion of components should be able to be monitored and the status of monitored motions should be able to transfer or save into cloud storage through reliable transmission. The data can be easily obtained or automatically sent back to the management control center of the machine tool manufacturer and transformed into a readable format for data analysis. This is the concept of "Big Data" for the machine tool manufacturer. Fig. 1 shows the capability of monitoring control of the high speed spindle, to guarantee the machine tool meets the demands of Industrie 4.0, ensuring computer design/CAD/CAM, CNC, Servo-Drive, machine and program are all in the monitoring control range. Under any status, the vibration recorder can record the over standard vibration value and store this data in the cloud.

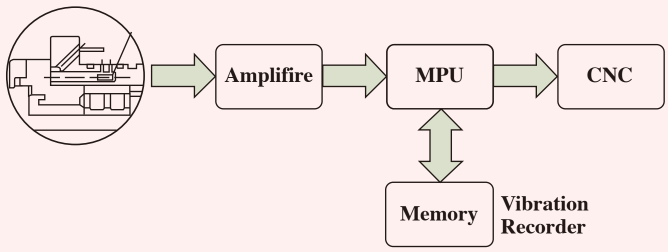


Fig. 1: Machine tool monitoring block diagram

Energy saving, high efficiency and high quality are the prerequisites for the technology of high speed machining. However, high speed machining will generate overwhelming load for the machine tool, for example, the rising temperature, wear, vibration and metal fatigue. Furthermore, when working with high metal removal rates under high speed machining, the machine operating rate increases exponentially. This is a big challenge for the operator; under such high speed operating if machine collision occurs, the operator or monitor may not be aware that the collision may cause inaccuracy in the precision component. Thus, the machine may continue operating under high speed with further impairment which will reduce the machine's lifespan and will lead to the interruption of production and seriously affect productivity.

Monitoring anomalies is necessary to ensure machine reliability. Monitoring is achieved through data collection, not only to provide references for maintenance in order to avoid serious damage to the machine and productivity but also to yield valuable reference for further Research and Development by analyzing operating habits, cutting conditions and machine return status. Data analysis provides an important reference to enhance the performance of the machine tools and to understand the industrial applications. These have significant benefits for the manufacturing industry in redeveloping the machine tool for the future.

The President of Buffalo Machinery,
A Smart Machining Technology Service

Dr. Paul Chang
Aug. 2016

MICROCUT MCG-5X Honored the 24th Taiwan Excellence Gold Award and Taiwan Excellence Service Award

TAIWAN EXCELLENCE
GOLD AWARD 2016

Buffalo Machinery, a leading manufacturer of high-end machine tool and technical service, is pleased to receive the prestigious 2016 Taiwan Excellence Gold Award on 21 April, 2016. Buffalo Machinery made its first debut in the competition of Taiwan Excellence Award by the submission of Heavy Duty High-Speed Simultaneous 5-Axis Machining Center —MCG-5X, whose entry not only won itself the Taiwan Excellence Award but was nominated into the 30 pieces of products for the Taiwan Excellence Silver and Gold Award among 523 products and successfully made to the Top 10 and honored the Taiwan Excellence Gold Award. In the meantime, Buffalo Machinery's excellent customer service system has been recognized by the government and has been awarded the 1st edition of Taiwan Excellence Service Award under the direction of former President Mr. Ma Ying-jeou. Both awards are given to nominees who successfully demonstrate the product performance and service to the highest standards.

Over the years, the Taiwanese government actively keeps promoting the Taiwan Excellence products in a variety of ways, with the implementation of Taiwan's Industrial Advertising Plan which the Taiwan External Trade Development Council spares no effort to work on. Now, "Taiwan Excellence" is Taiwan's most important and most effective industrial endorsement. Moreover, it brings the domestic manufacturers to high attention every year. This year, there is an increment of 11.16% on participating manufacturers in Taiwan Excellence campaign.

In this event, the former President Ma Ying-jeou gave awards to the 10 Taiwan Excellence Gold Award winners and the 3 Service Award winners. He praised the 523 selected products of this year for their excellent quality, especially stressed that the 30 finalists of Silver and Gold Award products all show high performance not only in product itself but also in the breakthrough technology, innovation, design and marketing aspects of every enterprise. He also made the remark that Taiwan was ranked No. 11 among 61 economies, and No. 3 in Asia, after Hong Kong and Singapore according to the IMD's World Competitiveness Yearbook 2015. The result indicates that Taiwan's economic performance is regaining momentum and the scientific and technological infrastructures remain competitive year by year. The former President Ma said the rankings especially reflect the great achievement by Taiwan's efforts in innovation.

Former President Ma Ying-jeou took a photo with all Gold Award winners to commemorate their hour of victory

Taiwan Excellence Gold Award

Taiwan Excellence Award honors Taiwan's most innovative and value-added products by the Ministry of Economic Affairs (MOEA). It was divided into three categories to separately represent three levels of honor: Gold Award, Silver Award and Taiwan Excellence Award. The assessment was based on each product's R&D including innovation, Quality, Design, and Marketing with equal importance and must be made in Taiwan. The overall symbol design shows six interwoven curves inspired by the spirit of "fulfillment" in the traditional Taiwanese culture.

The winners of the Gold Award are selected from the Taiwan Excellence Award winners. The judging committee selected winner based on the products' ability to demonstrate innovation and creation in all major categories. This year, a total of 1180 products from 498 companies participated in this attention-gathered event. Much to our delight, Buffalo's MCG-5 stands out among other candidates and tops itself to one of the 10 Taiwan Excellent Gold Award winners.

Former President Ma Ying-jeou presented Gold Award to Buffalo Machinery General Manager Paul Chang

Heavy Duty High-Speed Simultaneous 5-Axis Machining Center MCG-5X

TAIWAN EXCELLENCE
GOLD AWARD 2016

MICROCUT MCG-5X gantry machining center integrates high speed machining technology and meets various industry demands with superior performance. Designed with high accuracy, speedy processing and rigid construction to support simultaneous machining and multi-tasking machining, MCG-5X strengthens and widens the efficiency of machining application while increasing productivity.

The gantry construction of MCG-5X provides the most rigid structure to endure high-speed and process-intensive machining when machining the complex and heavy-duty workpieces. The 5 axes simultaneous machining is provided with 3 axes of high dynamics tool motion and 2 axes workpiece motion by the rotary table which is driven by built-in motors with high torque.

Also featuring with the integration of Buffalo's patented technology —Smart Machining Technology (SMT), the innovative and advanced functions combined with automotive supervision and precise compensation allow MCG-5X's simultaneous 5-axis machining to achieve the best working conditions and perform further with higher accuracy, better surface roughness, optimal productivity and better cost efficiency.

Taiwan Excellence Service Award

President Ma Ying-jeou presented Sevice Award to Buffalo Machinery Sales Manager Angie Tseng

The “Taiwan Excellence Service Award” was newly introduced to select and applaud enterprises that create value for customers and provide excellent customer service. On April 21, the former President Ma Ying-jeou personally presented the award to the three winning enterprises: Johnson Health Tech Co., Ltd.; Tatung Co.; and Buffalo Machinery Co., Ltd.

Buffalo Machinery is delighted to receive this award as recognition on service. Taiwan Excellence Service Award focuses on five aspects of the services including customer needs, customer service, after-sales service, customer satisfaction, and customer relations. The committee visited the service sites of each enterprise and gave rigorous examination of their services operation, then came to the decision the 3 final winners.

In addition to the research and development of innovative products, Buffalo puts high regards to the service quality and takes customer satisfaction as the core value. Upholding the company value of “Quality and Service Build our Business”, Buffalo Machinery created its own brand “MICROCUT—The Challenger” to bring the high-end machine tools to global markets and set up the service network with instant support. For perpetual operation, Buffalo Machinery actively improves the enterprise constitution for the long-term operation and continuing growth by implementing Total Quality Management (TQM). With the implementation of the overall reviewing and analyzing approach, the whole business process was upgraded towards a higher quality in all aspects.

As the former President Ma mentioned in the address that, in the future, the great enterprises shall focus as much on customers and consumers as on the R&D, production and services. Enterprises must understand customers’ needs and develop a variety of innovative business models for their services. With the steady improvement on management, it helps to enhance service competitiveness and bring added value. This points out that a new business concept is worthy of developing and practicing by enterprises. As the grantee enterprise of the first round service award, the recognition has a profound meaning to Buffalo’s striving direction and brings stronger momentum toward the next phase.

MCG-5X Your Best Choice for 5-Axis Mach

Simultaneous 5-Axis Vertical Machining Center

As one of leading manufacturers of 5-axis machining centers in Taiwan, Buffalo has over 30 years experiences in machine design and manufacturing. Buffalo's exclusive 5-Axis Machining Center has been successfully applied to many industrial sectors and high-speed manuafacturing fields.

The **MICROCUT MCG-5X** is a simultaneous 5-Axis Machining Center designed with the concepts of high-reliability and high performance. The highly enhanced structure and reliability give users the ability to manufacture not only for complex contouring but high precision for heavy-duty machining with better metal removal rate than average.

The **MICROCUT MCG-5X** satisfies the industrial demands for contouring accuracy, precision machining, optimal removal rate and prolonged tool life which can establish efficient production and higher productivity, and ideally for high tensile material machining of Aerospace, Medical, Automotive, and Die & Mold industries.

Aerospace industry

Precision machining and HSM

Automobile industry

High availability and mass volume

Medical industry

High precision and high efficiency on hard material machining

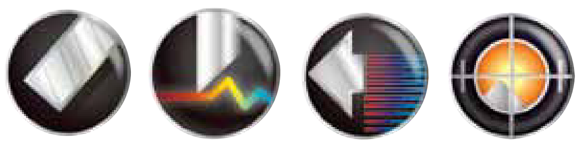
Die & mold industry

High kinematic energy process 5-axis simultaneous machining

Machine Highlight

MICROCUT MCG-5X gantry machining center integrated with high speed machining technology and meets all industry demand. Designed with high accuracy, speedy processing and rigid construction to support simultaneous machining and multi-tasking machining, MCG-5X strengthens and widens the efficiency of machining application while increasing productivity. With patented solutions “Smart Machining Technology” to vibration and thermal issues, MCG-5X achieves better finish, productivity and efficiency.

With its expert performance of High Speed Cutting, a power comsumption saving can be up to 20% and the self learning system supports machining time to be 19% minimum based on the experiment on a normal steel cutting.



TPC SVS MRRO AAC

- MCG-5X design is based on an advanced gantry construction giving the most powerful structure to achieve the best working conditions when machining the complex workpieces. 5 axes continuous machining is provided by high dynamics tool motion (3 axes) and workpiece motion (2 axes) of which rotary axes in the table are driven by built-in motors with high torque.
- Z-Axis is embedded with US-patented 3-roller guideways
- Anti-friction linear guideways—The large diameter roller type linear guideways on all axes ensure high-speed movement.
- Collision protection—the collision protection function protects the spindle and table during complicated machining.
- Large working area—In the working area, large space for free movement.
- High torque driven table — with super high loading capacity at max. 1,200kgs.
- Accessibility—Easy for parts loading / unloading
- Pick-up magazine is driven by servo motors, offering stable and rapid tool changing action as well as less interference with working area.
- The optimized wiring design is provided for easy maintenance and service.

ining Solution

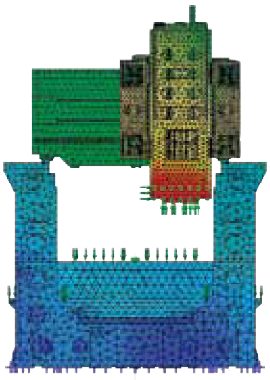
Mechanical Simulation

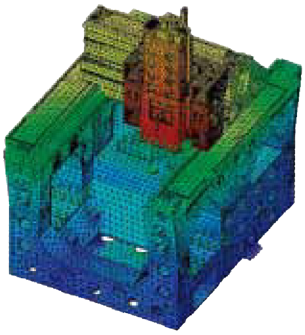
Optimized machine structure for complex
5-axis heavy-duty machining

The MCG-5X has been implementing static and dynamic modal analysis to ensure the machine rigidity and to have optimal performance prior to manufacturing.

Optimized 5-Axis Machining Structure

All structural components and the whole machine frame of MCG-5X were analyzed by the ANSYS mechanical system and the Finite Element Method (FEM) to ensure structural optimization





High Reliability

For long-term high-speed operation

MTBF and remote detect system are built for rapid service

40-hour reliability testing assures reliability under complex loading conditions

Rotary Table Dia. 600/650/800mm
Max. table load 850kg(Ø600mm); 1300kg(Ø650/Ø800mm)
X travel 670mm Y travel 820mm Z travel 600mm
Spindle speed 12000~24000rpm
X/Y/Z rapid feed rate 60m/min

Global Outlook

USA

USA Flag by Mike Mozart on Flickr

New York skyline from Rockefeller Center. Photo by Jerry Ferguson on Flickr

Commonly referred to as United States (U.S.) or America, United States of America (U.S.A.) is a country of immigration with multicultural diversities. In 1776, the American colonies in Britain broke with the mother country, and were recognized as the new nation of the United States of America following Treaty of Paris in 1783. Geographically, it is the world's third largest country after Russia and Canada and by population after China and India, accounting for 321.4 million people.

The federal republic of America is composed of 50 states, with 48 contiguous states and Washington D.C. in Central America between Canada and Mexico, and the state of Alaska in the northwestern part of North America and the state of Hawaii being an archipelago in the mid-Pacific, reported Wikipedia. With a short history of 240 years, today, the United States has one of the strongest economies in the world by nominal and real GDP thanks to its bountiful natural resources and high work productivity, at $110,050 (constant 2011 PPP international dollars) per person engaged in 2014. However, the US economy in 2014 has fallen to the second place behind China, which has more than tripled the US growth rate annually for the past four decades.

USA Map by Joe Wolf on Flickr

Economy

Imported crude oil accounts for nearly 55% of the US consumption, therefore, oil has a major impact on the overall health of the energy-intensive US economy. Prices of crude oil doubled between 2001 and 2006, home prices peaked at the

same year which caused mortgage crisis. Between 2006 and 2008(See Chart 1), oil prices doubled again and bank foreclosures more than doubled. However, after the significant drop in 2009, the falling oil price since 2014 has eased many of the problems created by earlier increases. However, when oil price contracts at least 20% annually, the machine tool consumption tends to decline at least -20% within the next two years. The significant drop in oil price in 2015 is pointing towards a contraction in machine tool consumption in 2016.

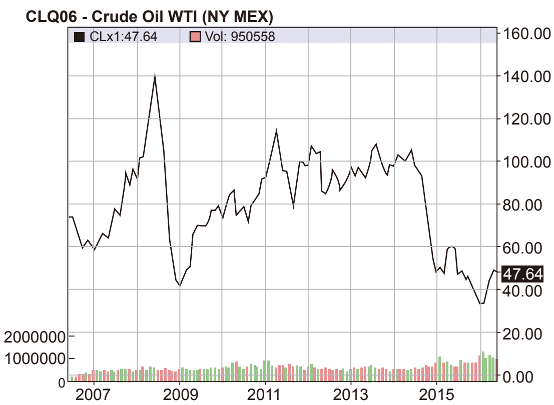


Chart 1: Commodity Price for Crude Oil WTI (NYMEX)

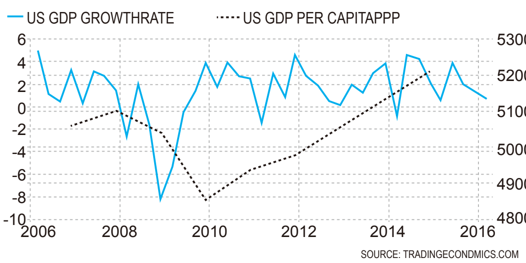


Chart 2: US GDP growth rate V.S. US GDP per capita PPP, Year 2006-2016
Source: TRADINGECONOMICS.COM

Manufacturing Competitiveness

The United States is considered to have a post-industrial economy, but it still maintains its role as the world's largest manufacturer, producing 19% of all globally manufactured products in 2013, accounting for 34% in global military and 23% of world GDP. The United States' share of the world's total GDP (at constant prices and constant exchange rates) declined from 28% in 2004 to 26% in 2014. Since 2010, the United States improved its ranking of the world's most competitive countries from 4th to 2nd in 2016. It is expected that United States will take over China's place as the world's most competitive country in the manufacturing industry by 2020, indicated in Table 1. Moreover, United States' unemployment rate was 4.9% of January 2016, which is a marked improvement from the 6.2% jobless rate in 2014.

Table 1: Global CEO survey:2016 Global manufacturing competitiveness index rankings by country

2016 (Current)			2020 (Projected)			
Rank	Country	Index score (100=High) (10=Low)	Rank	2016 vs. 2020	Country	Index score (100=High) (10=Low)
1	China	100.0	1	(▲+1)	United States	100.0
2	United States	99.5	2	(▼-1)	China	93.5
3	Germany	93.9	3	(↔)	Germany	90.8
4	Japan	80.4	4	(↔)	Japan	78.0
5	South Korea	76.7	5	(▲+6)	India	77.5
6	United Kingdom	75.8	6	(▼-1)	South Korea	77.0
7	Taiwan	72.9	7	(▲+1)	Mexico	75.9
8	Mexico	69.5	8	(▼-2)	United Kingdom	73.8
9	Canada	68.7	9	(▼-2)	Taiwan	72.1
10	Singapore	68.4	10	(▼-1)	Canada	68.1
11	India	67.2	11	(▼-1)	Singapore	67.6
12	Switzerland	63.6	12	(▲+6)	Vietnam	65.5

Global CEO survey:2016 Global manufacturing competitiveness index rankings by country

Rest

Source: Deloitte Touche Tohmatsu Limited and US Council on Competitiveness, 2016 Global Manufacturing Competitiveness Index

Advantages

United States plays a leading role in global technological research, accounting for 61,492 or 29% of patents filed by all countries in 2014. The US's expenditure on basic research significantly overpasses the second highest spender, with $64.4 billion to Japan's $16.0 billion in 2013.

Low cost of shale gas in the US attracts investors in energy-intensive industries such as chemicals at averaged $4.35 per million British thermal units in 2014 compared to $8.33 in the UK, $9.11 in Germany and $16.33 in Japan(See Figure 1). The United States' aerospace products cashflow in 2016 is $95.6 billion dollars, up by 44.5% since 2011, which indicates US's strong competitiveness in aerospace industry.

Country	Shale gas price in 2014(per million British thermal units)
US	$4.35
UK	$8.33
Germany	$9.11
Japan	$16.33

Figure 1: Shale gas price in 2014
Source: Deloitte Touche Tohmatsu Limited analysis

Disadvantages

According to the United States Census Bureau, the US population aging is slower than other countries, which is positive to the supply of workforce. However, the increasing cost labor in the United States was extremely higher than in emerging countries like China and India. Furthermore, the shortage of talent pool and rising needs in these markets have been a huge disadvantage to US manufacturing.

Machine Tools Manufacturing

World consumption and production

Gardner Research reported that global machine tool consumption in 2015 was $79.1 billion, down $10.6 billion, decreased 11.8% compared to 2014. North America consumed $10.8 billion, down 11.2 % from the year before. Taking the most recent peak 2011 as a baseline, the consumption of machine tools in the US is down just nearly 5% if compared to Asia's most significant countries which drop at least 25% over the last four years.

In 2015, global production of machine tools declined 11.9% compared to 2014. The big drop in machine tool consumption in Asia results in its reliance on the export market. Thus, the decrease of production in Asia is lower than that of Europe. The United States lost its position in the top 5 producing country in 2014 and 2015, coming down to the sixth.

In 2016, it is predicted that the consumption of US machine tools will be $6,256.9 million or 17.6% decline due to the drop of oil price. The expenditure for the biggest consumer China will be $22,000 million, or 25% decline whilst Germany as number three consumer will put in $6042.8 million, with slightly drop of 5.3% to the previous year.

US metalworking capital spending

With significantly over-expected capital spending in 2014 and 2015, Gardner Research estimated that in 2016, there will be a major decline in the US metalworking capital spending, with $6,217 billion or 15% decline compared to $7,281 billion in 2015. This is due to the slower growth in the money supply, contraction in capacity utilization, significant decline in the price of oil and the rapid rise in the U.S. dollar.

The imports of machine tools in the US account for $4,506 million, or 61% to the total consumption in 2015. The Top spending industries remain the same, in machinery, automotive and aerospace industries. Table 2 shows that, in 2016, there are significant declines in machinery/equipment, automotive and aerospace industries of respectively 38%, 29.9% and 22.8% whilst the job shops industry shows an increase of 11.7%, from $1,600.4 million to $1,736.7 million. It is important to know that spending on the oil and gas industry has bounced back, from $42.6 million to $112.7 million in 2016, 50% of that of 2010. In addition, the spending on military has increased to $53.7 million, or 148.6% increase.

Top Spending Industries	2010	2015	2016
Job Shops	968.2	1,600.4	1,736.7
Machinery/Equipment	162.5	1,086.3	673.1
Automotive	216.8	888.9	623.2
Aerospace	307.8	572.9	442.1
Oil/Gas-Field/Mining Machinery	229.2	42.6	112.7
Military	12.6	21.6	53.7

Table 2: US machine tool top Spending Industries(forecast for 2016)
Source: Gardner Research

According to the Gardner Research, spending in the North Central-East region is slightly down from the previous year's $1,954.7 million to $1,805 million in 2016. However, the North Central-West will have a significant increase, from the previous year's $1,390.6 million to $1,676.7 million in 2016. These two regions will account for 56% of 2016's total machine tool spending. But the South Central will drop significantly from $894.5 million to $488.8 million due to the influence by the oil and gas industry.

Spending By Region	2010	2015	2016
North Central-East	707.2	1,954.7	1,805.0
North Central-West	613.2	1,390.6	1,676.7
Northeast	623.5	1,231.5	889.3
West	496.7	1,107.6	779.6
Southeast	326.4	702.2	577.4
South Central	463.0	894.5	488.8

Table 3: US machine tool Spending by Region(forecast for 2016)
Source: Gardner Research

Reference:
http://www.census.gov/
https://www.cia.gov/library/publications/the-world-factbook/geos/us.html
http://www2.deloitte.com/us/en/pages/manufacturing/articles/global-manufacturing-competitiveness-index.html
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http://www.tradingeconomics.com/united-states/gdp-growth
http://www.nasdaq.com/markets/crude-oil.aspx?timeframe=10y

Economical Plug-and-Play Solutions

Linear guidance systems for machine tools and special machinery

Many functions in few components – this is how Schaeffler implements economic linear guidance systems. These systems are designed and manufactured both as standard products and as customized versions. Plug-and-play sub-systems including engineering, drive technology and additional services such as final assembly, wiring, parameterization of the control system and startup procedure are available.

Linear guides, toothed belt drives and ball screw drives, planetary gearboxes, measuring systems, rotary encoders, carriages, lubrication systems, limit switches and covers are integrated into in-house, proprietary aluminum extruded sections. These are optimized for the respective load conditions with the help of FEM.

Telescopic actuator MTKUSE: Extra space for machine tools

Telescopic axes do not extend across the entire travel distance and thus leave more work space free for other machines and processes. The machine can be designed more flexibly, and the transfer to areas behind safety panels or separate work areas becomes possible.

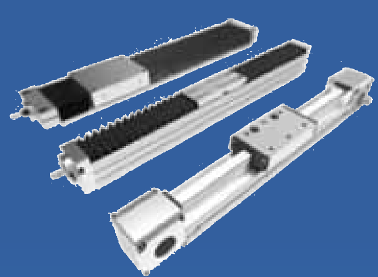
The telescopic actuator MTKUSE is designed specifically for secondary axes as in pick-and-place applications or in tool transfer devices. It includes three high-precision linear ball bearing and guideway assemblies that are arranged one above the other so that the possible travel distance is more than twice as long as the base actuator itself. The linear unit can be telescoped in both directions. A geared servomotor is externally flanged to the aluminum profile and drives the actuator via a rack and pinion drive. Upon customer request, servomotors from a wide range of different manufacturers as well as accordingly prepared low clearance high-precision planetary gearboxes can be installed or limit switches and linear encoders integrated. The servo controller facilitates an indirect evaluation of the frictional torque and thus the bearing condition by means of current detection and by tracking error monitoring.

High-precision linear table LTP: High positioning and repeat accuracy

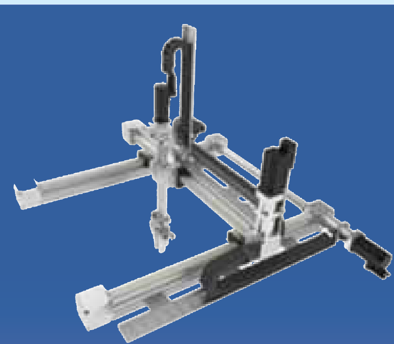
High-precision linear tables LTP are used when tools need to be moved precisely and with a high level of repeat accuracy during machining or monitoring operations. The linear slide is supported with a precision-manufactured aluminum plate on high-precision linear ball bearing and guideway assemblies that provide quiet, low-noise operation combined with low sliding resistance. The unit is powered by a servomotor and a ball screw drive. Alternatively, a direct-drive version is possible too. Linear encoders and position switches are applied in keeping with customer specifications. High-precision linear tables LTP are available in three sizes delivery in a vibration-damping gray cast iron version is an option. For protection against the ingress of foreign particles and liquids, the LTP can be equipped with bellows or with a metal telescopic cover. The KGEH coupling housing has been developed as an open interface to ensure that servomotors from various manufacturers can be installed according to customer requirements. Indirect evaluation of the frictional torque and thus the bearing condition is possible via the servo controller. The high-precision linear tables are used as auxiliary axes in machine tools, for example in tool transfer devices or as a drive for laser delivery in tool marking and coding applications.

The Challenger would like to acknowledge Schaeffler for the contribution of material.

Telescopic actuator MTKUSE combined with a linear actuator MDKUVE25-KGT



Excerpt from Schaeffler's portfolio of linear actuators and linear tables (from left): linear table LTS-KGT, linear actuator MKUVE-KGT, linear actuator MLF-ZR



Individual system solution incl. connectors and drive technology from Schaeffler

Open MICROCUT High-End Machine Tool Market in Croatia – ŠELA PROIZVODNJA Ltd.

Through careful assessment and planning, ŠELA PROIZVODNJA has made a professional decision to place an order for a total of 7 MICROCUT high-end machines, covering complete 5-Axis series (MCG-5X, MCU-5X and V-20/5) and high-speed series(V-20, V-22, V-26 and V30) which have been delivered in the first quarter of 2016. For this, it is a pleasure to know that MICROCUT EUROPE has successfully promoted the MICROCUT high-end products in Croatia and to believe the business will continuously bring mutual benefits and success for ŠELA PROIZVODNJA and MICROCUT in the long run.

MICROCUT V series and 5-Axis series combine the ergonomic design features and the patented MICROCUT's Smart Machining Technology to ensure high-speed and process-intensive machining, both are ideal models to achieve the best performance under high-speed machining in many industries. Adopting complete series of high-end MICROCUT machines will come along with efficient and professional maintenance and service, in the meantime, the strategy makes the integrity management of facilities much more effective.

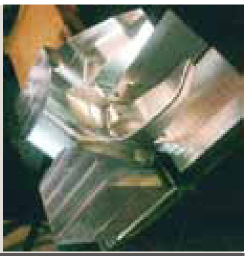
ŠELA PROIZVODNJA was founded in 2009 in Zagreb, Croatia, a young company stemming from the family foundry of 110-year tradition in the processing of metalworking. As early as 1900s, the Šelendić family foundry in form of workshop was the family ancestor to enter the field of industry, which used to be recorded in the book "Na osposobljenje vezani obrt, 1900-1914" according to the reports of the national archives. In 1947, Mr. Zeljko Šelendić set up Šelendić manufacturing company to supply brake equipments for Croatia railway and therein consolidated its position as a leading manufacturer in Croatia since then. As the industrial market continued to expand, in 2009, ŠELA PROIZVODNJA set up to provide more quality products and services to satisfy the enlarged market demands.

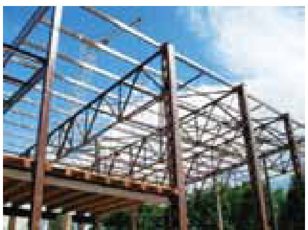
For seven years of endeavor, ŠELA PROIZVODNJA is now a reputable and reliable company in the domestic market. The company now has grown to have three production halls in two locations of Zagreb, Croatia, providing a total of 3000m^2 spaces with advanced facilities to manufacture various production lines.

Office and the production areas of ŠELA PROIZVODNJA

The company mainly provides high-quality CNC machining production such as railway parts and automotive parts, and develops and manufactures brake equipments and locksmiths as well, which separately accounts for 70%, 15% and 15% of the company’s activities.


Brake Device


Automotive parts


Locksmith parts

Through years of industrial experience and manufacturing knowledge, today’s ŠELA PROIZVODNJA upgrades the production facilities to cope with customer’s demands and pursuit higher performance and productivity including adopting cutting-edge HSM and 5-Axis machine tools to provide diversification of production, setting up machines to exclusively process sheet metal and steel construction. Besides, ŠELA PROIZVODNJA deployed the complete set of measuring and testing equipments and created a superior manufacturing environment to ensure project success.


Automotive part

In addition to setting advanced production facilities, ŠELA PROIZVODNJA has a team of qualified employees who are well trained on ISO standards to perform the production work.The focus of high-standard qulity also reflects in the production processes which are strictly compliant with EN ISO Standards to meet the essential requirements and guarantee the completeness and soundness of manufacturing processes. While attempting to go beyond the market, they never make trade-offs in quality and tradition.

As a young company but with a long tradition, ŠELA inherits more than the adherence of quality but also the Šelendić family’s honor, which urges ŠELA PROIZVODNJA to keep efforts on their goal, thus win trust and recognition from customers of the industry by their premium products and services. Today's ŠELA PROIZVODNJA aims to become a leader in the region and go beyond in the development of braking equipment, brake parts and equipment for the rail vehicles, and air brakes. Inheriting the craft tradition as the core and evolving as technology advances, ŠELA PROIZVODNJA has kept developing with the original entrepreneurial spirit and adhered to manufacture quality products of all projects, and keep pace with advanced industries on their technical innovation all the time.


Hundred years of craft in Šelendić Family

Buffalo Machinery feels proud and honored to provide quality products and services to ŠELA PROIZVODNJA as a high-end machine tools provider. Adapting the highest performance and quality machines with complete technology is definitely the smart way to optimize the productivity. The business foresight to make plan of facility makes it a wise investment. Herein, Buffalo Machinery appreciates ŠELA PROIZVODNJA‘s approval of products and sincerely wishes ŠELA PROIZVODNJA every success in the future.

The Challenger would like to acknowledge ŠELA PROIZVODNJA for the contribution of photos and information.

Design Improvements with Vibration Engineering

Dr. Yum Ji Chan, Department of Mechanical Engineering, National Chung Hsing University

1. Introduction

In traditional engineering design, the primary criteria to be considered are strength of components and fatigue life. However, recent requirements in process time and the introduction of new materials to the aerospace and biomedical industry have increased the requirements on machining speeds, motion precision and machining stiffness. Under these circumstances, the dynamic behaviour of machine tools, particularly vibrations, becomes an increasing concern. It is also found that that the age-old problem of chatter is also related to certain characteristics of machine tool dynamics. These problems require solutions drawn from vibration analysis.

In this article, the applications of vibration engineering in design are discussed in the rest of Section 1. Key concepts of vibration theory are discussed in Part 2. Examples of vibration engineering in machine tool design are shown in Section 3, before a brief discussion is made.

Figure 1 Traditional “vibration analysis

1.1 Role of vibration analysis in design

Vibration analysis encompasses theory in solid mechanics, signal processing and automatic control. In addition, validation of predicted vibration properties require attention to details in experiments. Both the theoretical and experimental components contribute to the delivery of a total solution.

Traditionally, while many factors are considered in machine design, dynamic analysis was considered to be unnecessary, or thought to be impossible. Vibration analysis comes after problems are encountered in operation (Figure 1). This “reactive” approach, however stupid it appears, forms the main workflow in the past, including in prominent projects such as the Millennium Footbridge in London [1]. In that case, vibration levels were found to be increasing suddenly, after a critical amount of people stepped onto the bridge at the “soft” opening. Vibration engineers were called in, an additional dampers are added near to the piers and under the bridge deck. It took more than a year to correct the vibration-related problems in this case.

Needless to say, the traditional approach is far from desirable. It leads to delays in delivery, some parts of a structure are very costly to be changed, if possible at all. To shorten development time, it is hoped that machine properties are predicted better before production with knowledge in vibration analysis. To show it graphically, a development process in the future should look like the one in Figure 2:

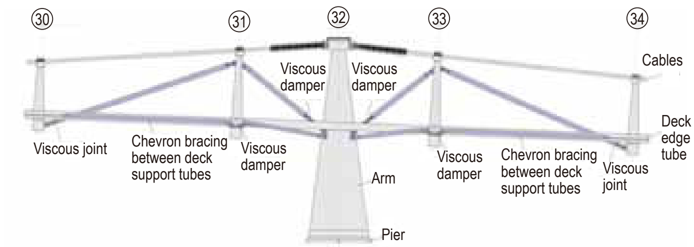


Figure 2 Original structure of the footbridge near to the pier (grey) and retrofit vibration damping devices (purple) (Taken from [1])

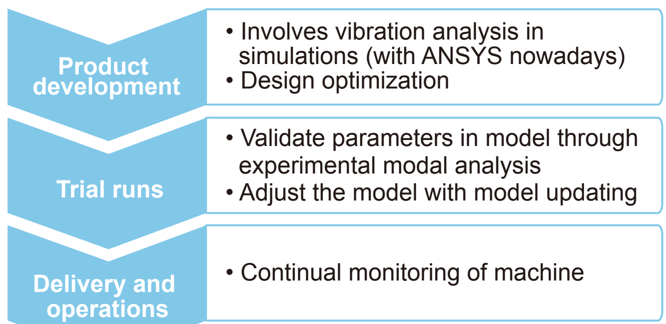


Figure 3 Desired development process involving vibration engineering

2. Theory

2.1 Dynamic stiffness

In elementary physics, it is known that the force applied to stretch a spring is proportional to the change of length (Figure 4):

$$f = kx \tag{1}$$

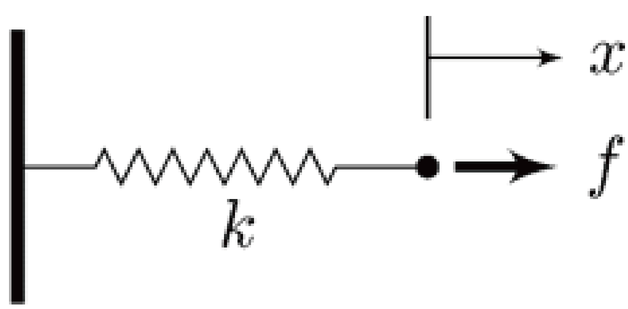


Figure 4 A simple spring

Equation (1) is valid for the static case, but the dynamic behaviour is found to be different. In machine operation, the force (also known as "excitation") is time-dependent, neither is the motion (also known as "response"). To analyse such a problem, the excitation force $F(t)$ is assumed to be a sine wave and the response $x(t)$ is also a sine wave, with the same frequency, denoted f. Therefore, we have

$$F(t) = F \sin 2\pi f t \tag{2a}$$
$$x(t) = X \sin (2\pi f t + \Theta) \tag{2b}$$
$$k_d = F/X \tag{2c}$$

The term k_d is usually known as dynamic stiffness. It is found that $k_d(f)$ is independent of t but dependent on frequency f. In typical presentation, the ratio $|x/F|$ is shown and it is alternatively called a frequency response function (FRF, Figure 1).

This FRF is technically called a "Receptance FRF" if it represents the ratio of displacement to force [2]. Another common FRF in use is the inertance FRF, which is the ratio of acceleration to force.

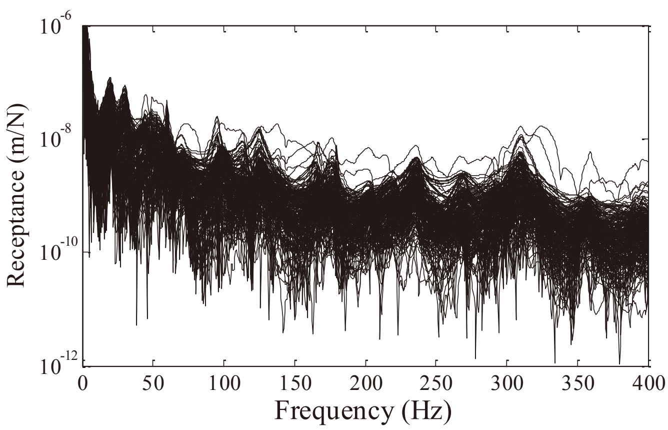


Figure 5 A typical receptance FRF in a machine tool

2.2 Existence of natural frequencies and action

According to Figure 3, there are several peaks, which correspond to high vibration amplitude under the excitation force of that frequency. In other words, resonance would occur at these frequencies, also known as natural frequencies, commonly denoted as ω_n. Natural frequencies of a component or a machine are dependent on the material, shape, and how the component is attached. For example, the first (or fundamental) natural frequency of a 0.5-metre-long simply-supported beam with 50-mm-square cross-section of are 8.64 Hz, while the same beam has a fundamental natural frequency of 5.16 Hz if it is cantilevered (Figure 6) [2]. Components with more complicated geometry are typically analysed using the Finite Element Method. Their dynamic properties are usually sought during engineering design stage.

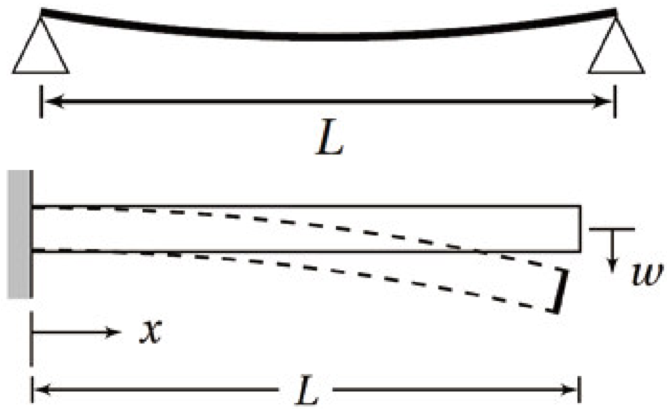


Figure 6 Simply-supported beam (left) and Cantilevered beam (right)

It should be emphasised that the existence of natural frequencies is unavoidable, but their effects can be reduced through addition of "damping", which are elements that dissipate mechanical energy of vibrations into heat (Figure 7). The level of damping to be applied to different parts of a machine require detailed calculations, as excessive damping would hinder the motion thus energy dissipation (Figure 8).

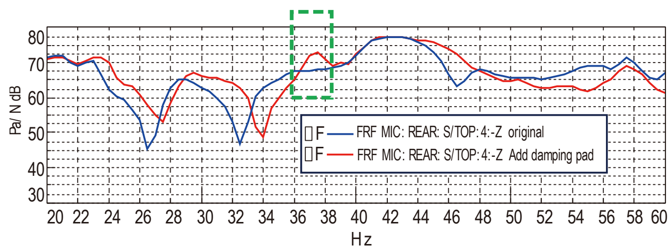


Figure 7 Additional damping brings a resonance peak down (in green box) [4]

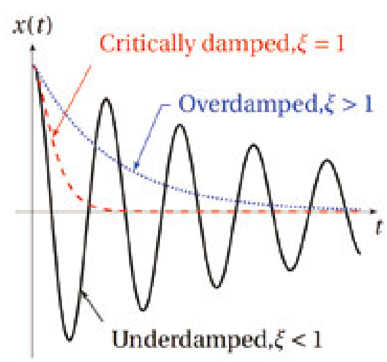


Figure 8 Consequences of too little damping (underdamped), optimal damping (critically damped) and too much damping (overdamped)

In operations, the effect of natural frequencies can also be reduced through optimal arrangement of machining paths and spindle speed.

Components and assemblies in real life always have more than one natural frequency, and several examples will be given in later sections. The natural frequencies are different from each other, as the "shapes of vibration" of different frequencies are different. These "shapes of vibration" are called mode shape of such a frequency.

2.3 Experimental Modal Analysis

In quality control, we need to confirm the natural frequencies. Also, there are several types of components where the actual properties are not known in advance. This is carried out using Experimental Modal Analysis (EMA) (also known as "modal testing" [2]).

In such an analysis, a measurable excitation force is provided on one of the measurement points. The responses are measured at the key points. In practice, force is applied using hammer or an electromagnetic shaker, and the responses of the structure are measured using accelerometers. Many accelerometers can be used at the same time, if the computer hardware is equipped with sufficient data acquisition (DAQ) modules.

Figure 9 Installation of accelerometers for experimental modal analysis

Through Fourier transform, the FRFs are first sought. Afterwards, the natural frequencies are sought with the aid of a stability diagram (Figure 10). At last, mode shapes are obtained from experimental data and compared with those obtained in computer simulations. There are numerous computer codes available to perform such a task, either sold by companies as packages or published in academic journals [3]. While it is still not fully automatic [3], recent advances has achieved semi-automatic. In these algorithms, the identified natural frequencies sometimes differ a lot from the true ones and operators need to distinguish them manually.

As mentioned before, the natural frequencies of a structure depend on the way of attachment. To extract the properties of the whole component, individual components are usually hung using piano strings, fishing lines or ropes to simulate the free-free boundary conditions, where ANSYS simulations are carried out. For whole machines where the weight acting on the joints/rails are important, the component will be put on the floor.

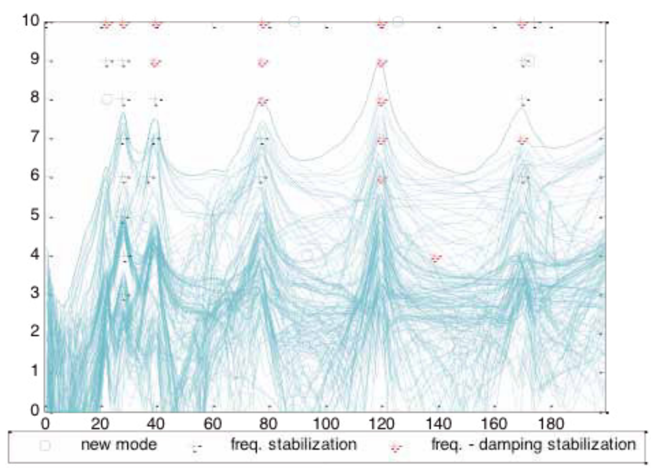


Figure 10 Stability diagram for natural frequency determination

3. Applications of Vibration engineering

3.1 Numerical model validation

A body of a machine tool is put under both finite element analysis and experimental modal analysis. It can be seen that the natural frequencies sought from two completely different methods are close to each other, and their vibration shapes are similar as well. It shows that the computer model is well-built, and further design changes can be estimated based on the computer model.

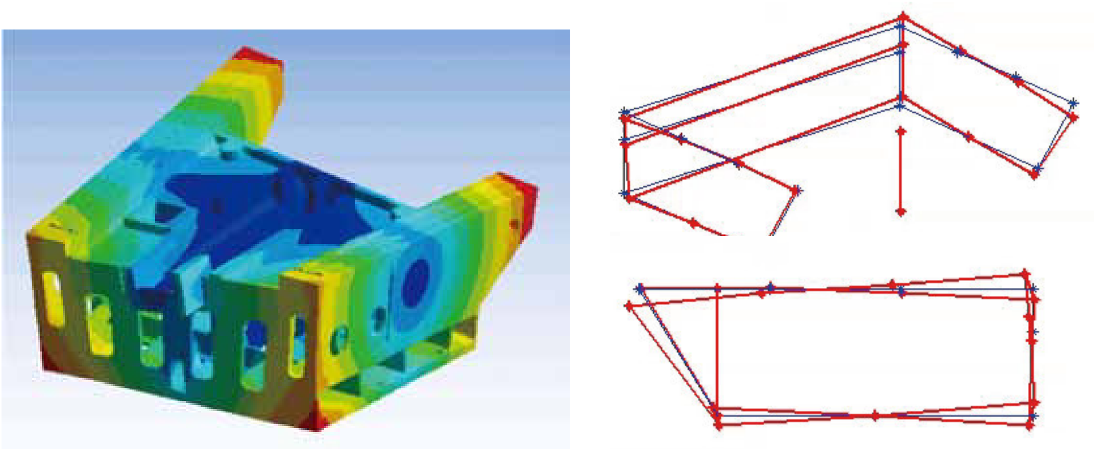


Figure 11 A mode shape obtained in ANSYS (left) and from experimental data (right)

3.2 Design Improvements

The slider of a machine tool was found to be not stiff enough. Therefore, a rib was lengthened. Although the mass increased by less than 5%, the natural frequency is nearly doubled. It shows that the stiffness of the slider is much improved. And unlike the stiffness, the natural frequency improvement is easily verified by using the experimental modal analysis as discussed in previous sections.

Figure 12 Original and improved slider designs

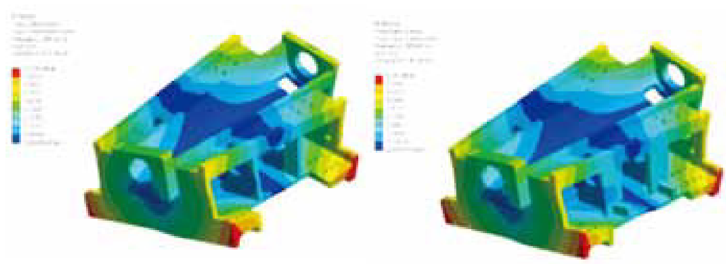


Figure 13 The first mode shape of original and improved slider designs

4. Conclusions

In this article, it has been shown that vibration engineering is useful in machine tool design, in both validating computer models and predicting the changes in properties related to design changes. Although the details of vibration engineering involve detailed calculations, the effects can be readily checked using experimental modal analysis.

5. Acknowledgements

This author would like to express sincerely thanks Wei-Shen Kuo and Sih-Ci You of National Chung Hsing University.

6. Bibliography

[1] P. Dallard, A. J. Fitzpatrick, A. Flint, S. L. Bourva, A. Low, R. M. R. Smith and M. Willford, "The London Millennium Footbridge".

[2] D. J. Ewins, Modal testing: Theory, practice and application, 2 ed., Research Studies Press, 2000.

[3] W. T. Thomson and M. D. Dahleh, Theory of Vibrations with Applications, Pearson Higher Education, 1997.

[4] Y.-p. Yang, "Analysis and Reduction of Automobile Interior Noise," National Chung Hsing University, 2016.

[5] B. Peeters, H. V. der Auweraer, P. Guillaume and J. Leuridan, "The PolyMAX frequency-domain method : a new standard for modal parameter estimation?," Shock and Vibration, vol. 11, pp. 395-409, 2004.

[6] E. Reynders, J. Houbrechts and G. D. Roeck, "Fully automated (operational) modal analysis," Mechanical Systems and Signal Processing , vol. 29, pp. 228-250, 2012.

The Reliability Model and Prediction

Dr. YI-LIN HE, Dr. JERRY TANG, and HSUN-FU CHIANG

Abstract

The objective of reliability prediction is to find out the hardware design defects in the early development cycle of product design. When executing reliability prediction, basic tools of reliability engineering techniques will be applied, such as reliability measure and reliability model. This paper briefly introduces the reliability measure, including the definition and basic concept of mathematical functions. Meanwhile, in order to provide designers with the preliminary concept of the reliability measure of reliability engineering, the relation of reliability function, failure rate and Mean Time Between Failure (MTBF) are explained. The failure rate and MTBF are the metrics in reliability prediction. To simplify the complication of a system, reliability model is described in this paper. Finally, the calculation theories and resource of the failure rate in reliability prediction process are carried out.

I. The mathematical function for reliability measure

The time performance of product reliability can be described with reliability function. As functions are subject to change over time lapse, the definition of the product usage time is important. Reliability function is originated from Probability Density Function (PDF) and failure probability function. Table 1 presents the derivation for reliability function. The failure rate of a product's life span is obtained from the integration of probability density function, also called failure cumulative distribution function, unreliability function, or failure probability function. In addition, the failure rate function is called hazard function. And, the failure rate function and failure function are not identical.

While a product performs a task, the functions, F(t) and R(t), are to measure the probability of success and failure, respectively. There is no physical unit. The numerical range of F(t) and R(t) is between 0 and 1, both add up to 1. The failure rate uses the concept of "frequency," which is defined as failure frequency in a short time period. The concept of failure rate for production is similar to death rate for population. The unit of failure rate may failure times of product divide time, e.g. 0.5 failures/100 hr. The physical quantity of time can be replaced with length, distance or revolution.

Unlike the probability notation of reliability/unreliability function, the definition of failure rate turns the concept of probability into failures in a given time. Because the failure rate indicates how many failures occur in a given product number and time period, the behavior of failure become measurable and significant for engineers and customers.

Table I: The Functions of Reliability Measure

Name	Description of Function
PDF	$f(t)$
Failure probability function	$F(t)=\int_0^t f(t)dt$
Reliability function	$R(t)=1-F(t)$
Failure rate function	$h(t)=\frac{f(t)}{R(t)}=-\frac{d}{d(t)}[ln(R(t))]$

The failure probability density functions include exponential distribution, normal distribution, and Weibull distribution. The PDF of the exponential distribution and the Weibull distribution are listed in Table II. These functions are unique. A failure rate function is derived from a given reliability function, vice versa. As shown in Table II, the exponential distribution is one of the most often used PDF, and the failure rate is a constant. The failure rate of the Weibull distribution is dependent on time. Assuming that β=1, the failure rate of the Weibull distribution becomes a constant, identical to the exponential distribution.

Table II: The well-known PDFs, unreliability/reliability and hazard function

PDF name	Exponential distribution	Three-parameter Weibull distribution
$f(t)$	$\lambda e^{-\lambda t}$	$\frac{\beta(t-\delta)^{\beta-1}}{(\theta-\delta)^{\beta}} exp[-(\frac{(t-\delta)}{(\theta-\delta)})^{\beta}]$ $t \geq \delta \geq 0$
$F(t)$	$1-e^{-\lambda t}$	$1-exp[-(\frac{t-\delta}{\theta-\delta})^{\beta}]$
$R(t)$	$e^{-\lambda t}$	$exp[-(\frac{t-\delta}{\theta-\delta})^{\beta}]$
$h(t)$	λ	$\frac{\beta(t-\delta)^{\beta-1}}{(\theta-\delta)^{\beta}}$

The expected life of products, E(t), can be calculated by Equation (1). In general, the MTBF or the Mean Time To Failure(MTTF) are applied as the metrics of the product lifecycle. These two terms are confusing and have different meanings literally. The difference is that the MTBF is suitable for repairable products which can continue performing tasks after being repaired. For example, whenever a part of a machine tool is broken, the machine tool can operate again as usual after the broken parts are repaired. The MTTF is applicable for non-repairable or one-shot system.

$$E(t)=\int_0^{\infty} \tau f(\tau)\, d\tau=\int_0^{\infty} R(t)dt \qquad (3)$$

The expected life for the functions, listed in Table II, could be calculated by Equation (1), and then listed in Table III. The expected life of reliability metrics has the following features:

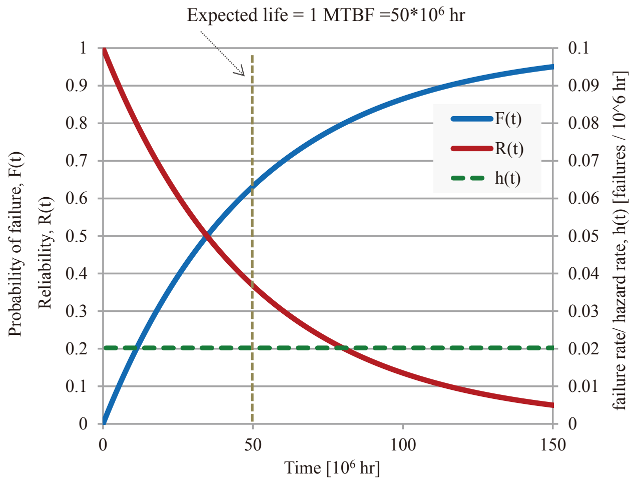
1. If the system allows that both repairable and failure rates are constants, the MTBF of exponential distribution function is the reciprocal of the failure rate. Then, the reliability function can be directly written as $R(t) = e^{-\lambda t} = e^{-t/MTBF}$ 。
2. Two products with the same MTBF metrics do not exactly have the same reliability level and curve profile. As shown in Equation (1), there is a high correlation between $E(t)$ and the reliability function. The same $E(t)$, e.g. equal to Table III, can be calculated from the infinite number of PDFs and reliability functions . This means different failure probability functions may come out with the same metric of the MTBF. However, it is not necessary to obtain the same reliability level while products operate the same MTBF. For example, as shown in Fig. 1, the PDF of two products, A and B, are the normal distribution and the exponential distribution, respectively. The expected life of two products is $E(t)$=$MTBF_A$ =$MTBF_B$=$MTBF$. Once the health product operated in $MTBF$, the reliability remains 0.5 and 0.368, respectively. The calculation result is shown in Table IV. As shown in Fig. 1, the reliability of exponential distribution is approximately 75% of the normal distribution.
3. The MTBF metrics does not presents the exact expected life of products.

Table III: The Expected life of failure probability functions

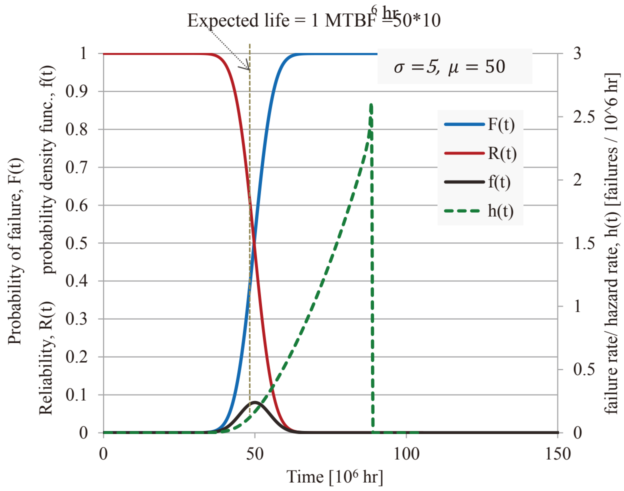
PDF name	Exponential distribution	Normal distribution	Two-parameter Weibull distribution
$E(t)$=$MTBF$	$\frac{1}{\lambda}$	μ	$\theta\Gamma\left(\frac{1}{\beta}+1\right)$

Table IV: The Calculation of the reliability of the usage time, *t=MTBF*

PDF name	Exponential distribution	Normal distribution
$R(t=MTBF)$	$e^{-\lambda \cdot MTBF} = 0.368$	$P(z\geq 0)=0.5$



(a) Product A : Exponential distribution



(b) Product B : Normal distribution

Fig. 1 The Curves of Failure Probability, Reliability and Failure Rate

II. The reliability model and the failure rate calculation of a system

The aforementioned content focuses on the reliability definition of an element or device, e.g. a motor, a relay, even a coil. A subsystem is composed of various elements and an overall system is composed of different subsystems. Therefore, to obtain the reliability function of an overall system, it is necessary to know the reliability of every subsystem and component in the subsystem. According to the functional relationship series-connected and parallel-connected between element to element and subsystem to subsystem, the reliability block diagram can be carried out firstly. Then, the overall system reliability could be calculated in advance. In the following, the calculation of series-connected system reliability is described.

Considering that a system is composed of various subsystems, the system reliability is shown in Fig. 2. In a series-connected system, to perform the system task successfully, the sufficient and necessary condition is that all subsystems and elements do not fail in the meantime. The complement of all events, that is $E_1 \sim E_n$, as shown in Fig. 3 The mathematics description is given by (2):

$$R_S = P(E_1 \cap E_2 \cap \ldots \cap E_n) \tag{2}$$

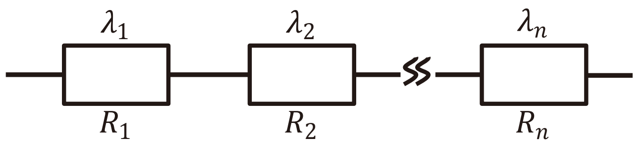


Fig. 2. The Reliability Block Diagram of a Series-connected System

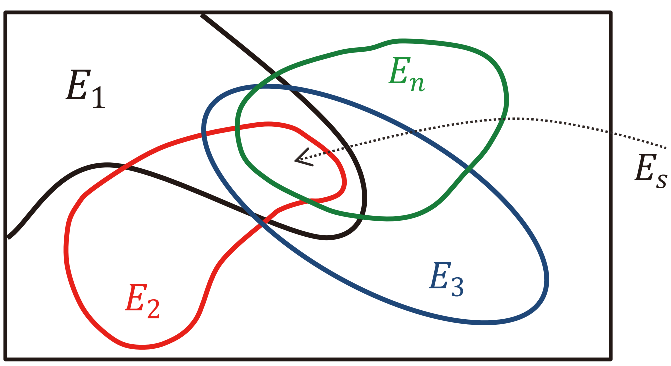


Fig. 3 The Venn Diagram of the Series-connected System

Assuming all the PDFs of elements in the system is the exponential distribution. The reliability of a series-connected system $R_s(t)$ is given by (3):

$$\begin{aligned} R_S(t) &= R_1 \cdot R_2 \cdot \cdots R_n \\ &= e^{-\lambda_1 t} \cdot e^{-\lambda_2 t} \cdot \cdots e^{-\lambda_n t} \\ &= e^{-\sum_{i=1}^{n} \lambda_i t} \end{aligned} \tag{3}$$

In (3), the calculation result is in exponential form; therefore, the reliability function of a connection system can be simplified as follows:

$$R_s(t) = e^{-\lambda_s t},\ \lambda_s = \sum_{i=1}^{n} \lambda_i \tag{4}$$

Function (4) shows that in the series-connected system, the summation of the failure rate of every subsystem is equal to the failure rate of an overall system. The MTBF of the series-connected system can be expressed as:

$$MTBF_s = \int_0^{\infty} e^{-\sum_{i=1}^{n} \lambda_i t}\, dt = \frac{1}{\sum_{i=1}^{n} \lambda_i} = \frac{1}{\lambda_s} \tag{4}$$

Therefore, as long as the PDF of all subsystems in series-connected form is the exponential distribution, the *MTBFs* is the reciprocal of the failure rate λ_s of a series-connected system.

III. The reliability prediction of the mechanical part of a system

It is important to fully understand system hardware, system function and the definition of system failure before the reliability prediction is performed. In general, in the process of product development, the reliability prediction will be carried out with FMECA simultaneously.

Verification of reliability design is carried out to inspect whether the products meet the requirement for customers, functionality and reliability. For example, a part needs to endure the load of 200 N, but the amount of deformation should be less than the standard (required by customers or regulations). During the three consecutive years of usage time, the amount of deformation should be less than 1mm. Furthermore, the part should be intact and do not fracture during the usage time. To successfully reach the objective of reliability verification, designers can predict the reliability beforehand or Reliability Test it afterwards. When designers perform the reliability prediction beforehand, analytical tools such as limited elements are used in computer simulation to help design the structure of certain parts and verify its functionality and reliability. However, while performing reliability test afterwards, the system/product prototype is required to build for the purpose of environmental verification and reliability test.

Reliability prediction is a part of design reliability verification; it is used to analyze the reliability as products execute a mission instead of its performance. In general, reliability prediction is applied at the early stage of product design and development. However, if using large test and field data for reliability verification, it is not only time-consuming but will also increase the research and development cost. Thus, the reliability prediction is considered as an efficient tool to predict the system reliability without a fully finished product. In contrast, the computer analysis simulation, test and inspection are needed for reliability prediction to make the most of functions.

The essential method to process the reliability prediction is to use the hands-on data, experience and basic mathematical techniques to calculate the system reliability. The resources for the reliability prediction are gathered from suppliers, research or government organizations. Some resources of the reliability prediction data are shown in Table IV. The NSWC-11 and Strength/Stress interference theory can be used to evaluate the reliability prediction of machine parts. Since the experiment hardware of reference books/data center and the analyzing hardware might not be manufactured in the same place, the manufacturing techniques and materials may differ. It is best to require relative data from suppliers and evaluate the failure data from the after-sale service to improve the credibility of reliability prediction. If the reliable data of some parts are not available, the parts would be experimented to obtain the reliability metrics.

Table V : Resources of the failure rate data of reliability prediction

Estimated target	Data source
Reliability of electronic parts	Handbook, such as Reliability Prediction of Electronic Equipment,MIL-HDBK-217F [1], Reliability Data Handbook –Universal Model for Reliability Prediction of Electronics Components, PCBs and Equipment, IEC-62380 [2] and Electronics Reliability Prediction, Bellcore/Telcordia [3]
Non-electronic or machine parts	Database and handbook, such as Mechanical Reliability Prediction, NSWC-11 [4] and Non-electronic parts reliability data, NPRD-95 [5] Strength/Stress interference theory

IV. Conclusion

This paper introduces the reliability functions, system model and prediction, then emphasizes the importance of design concept and application theories. Owing to the verifying systems with experiments are inefficient and expensive, the system reliability prediction concept can be applied to acquire the reliability of a system/element for designers. After the reliability prediction is performed, the predicted failure rate of a system is known. Hence, this process helps the designers to find out the system defects. Thus, it can improve and analyze the key areas and avoid unnecessary cost and extra time caused by further modification. In The Challenger 2016 Q4 Issue 31, the reliability prediction methods discussed here will be applied. The reliability prediction of an integrated spindle will be demonstrated to calculate the failure rate and MTBF of a system/element.

V. Reference

[1] Reliability Prediction of Electronic Equipment, MIL-HDBK-217F, Notice 2 1995, US Department of Defense.

[2] Reliability Data Handbook –Universal Model for Reliability Prediction of Electronics Components, PCBs and Equipment, IEC TR 62380, 2004, IEC.

[3] Handbook of Reliability Prediction Procedures for Mechanical Equipment, NSWC-11, 2011, US. Navy, 2011.

[4] Reliability Prediction Procedure for Electronic Equipment 2011, SR-332, Issue 3, Telcordia.

[5] Non-Electronic Parts Reliability Data, NPRD-95, 1995.

AMB 2016 Exhibition News

International Exhibition for Metalworking

AMB
International exhibition for metal working
13.-17.09.2016
Messe Stuttgart

Hall 5 Stand 5B30

Come and meet MICROCUT at AMB 2016

The leading industry trade fair for metalworking, AMB, will be held from 13th to 17th September at the Stuttgart Trade Fair Centre. As a biennial event, AMB occupies a leading position among the exhibitions in the industry and ranks the world's top five events. This year, more than 90,000 visitors and over 1,300 exhibitors are expected to attend AMB to present innovations and advanced developments for various metalworking industries and the precision tool industry on around 105,000 square meters of floor space.

In AMB 2016, the promotion of the younger generation and technological innovations is the main focus.

For technological innovations, the focus will be on the improved efficiency, Industry 4.0, increasing intelligence in the machine periphery and possibilities with regard to simulating the machining processes. Each day at the AMB Experts' Lounge, there will be 6 experts in each theme block to report the latest news on the topics of automation, autonomous manufacture, energy efficiency, additive manufacturing, lightweight construction and productivity reserves.

Meanwhile, AMB and sponsors from the Association of German Machine Tool Manufacturers (VDW) organize a new extensive program in order to raise interest among young people for their technical career in the machine tool industry. To promote the younger generation, competitions, special shows and career fairs are organized for young people to go through stages and get to know various manufacturing steps in practices, which is intended to attract youngsters to enter technical professions in the machine tool construction.

MICROCUT Offers High-End Solution for Automation

To correspond with the spirit of this globally prestigious trade fair, this year Buffalo Machinery will present a series of high-end machine tools for the application of 5-axis and high-speed machining, to well correlate the trend of Industry 4.0 by presenting its capability in advanced manufacturing as well as the application of the cutting-edge Smart Machining Technology (SMT) innovation on machining solution.

MCG-5X
5-Axis Vertical Machining Center

MCU-5X
5-Axis Vertical Machining Center

V series
High Speed Vertical Machining Center

Sustainable Innovation

Since the German Government released the final report of "Recommendations for implementing the strategic initiative INDUSTRIE 4.0" in 2013 in order to secure the future of German manufacturing industry, the global manufacturing industries have launched the supporting measures to meet the Industry 4.0 demands. Buffalo Machinery has started to research and study all the necessary constituents in order to design and build the high-end machines conformity to the criteria of the Industry 4.0.The calculation of Mean Time between Failures for all components is relatively important when design. To total control the machine production status and fully utilized the machine capability, to ensure the stability of production line, the machine reliability is another improtarnt issue to be considered. Other than above, there are more for Taiwan machine tool manufacturer to do further research and discover to ensure that the industry staying competitive.

Buffalo Machinery continually makes efforts in research and development on upgrading machines for the era of Industry 4.0. A lot of efforts from members, suppliers and resources are involved to overall enhance the machine reliability and performance to support the future trend of smart factories.

Reference:

Wolfram Huonker. (2016). Interesting framework programme for AMB 2016 [Press release]. Retrieved from http://www.messe-stuttgart.de/en/i-mobility/journalisten/pressematerial/detailseite/text/interesting-framework-programme-for-amb-2016//detail/PressText/

Exhibition Calendar

Month 2016	Period	Title of Exhibition / City, Country	Distribution Company
September	12~17	IMTS/ Chicago, IL, USA	Milltronics USA Hurco & Milltronics
	13~17	AMB / Messe Stuttgart, Germany	Buffalo Machinery
	21~23	Open House/ FRANCE	DIDELON MACHINES OUTILS
	Beginning of Sep.	Open House	FAMA
October	3~7	International Engineering Fair/ Brno, Czech Republic	ADATE
	4~8	BIMU MILANO/ Italy	Tecnor Machine
	11~18	Maktek Eurasia / Istanbul, Turkey	VATAN CNC
	11~18	Maktek Eurasia / Istanbul, Turkey	CELIK MAKINA TIC.A.S.
	Mid. of Oct.	Open house	BPK
November	15~18	PRODEX/ Basel, Switzerland	NEWEMAG
	16~18	Open House	VOLZ
	23~27	TMTS/ Taichung, Taiwan	Buffalo Machinery
December	Mid. of Dec.	Inauguration of Queretaro dealership	FAMA

FAQ

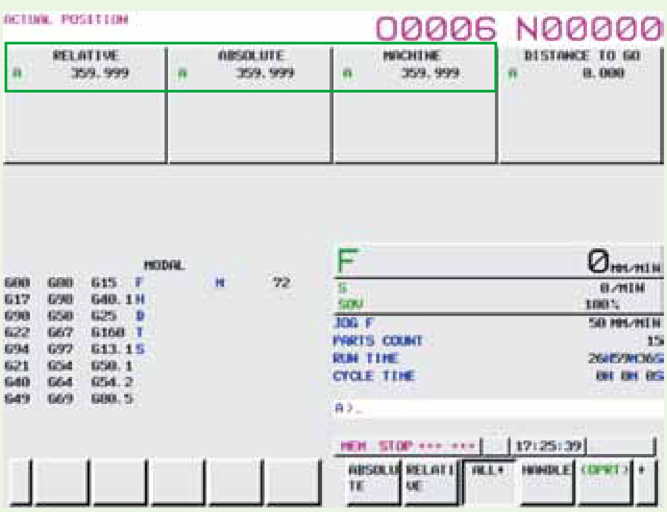
Q: How to offset the coordinates value for HBM models with FANUC 31iB/32iB manually?

A: Please refer to the instructions below to execute the manual-offset function.

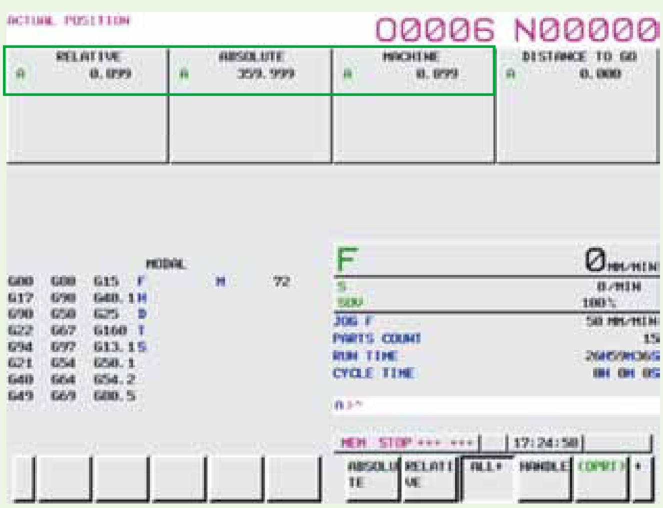
Step 1: Update the PLC to new version of HBM1-C2
Step 2: Set up the K-BIT K41#2=1
Step 3: Switch the mode to MDI MODE
Step 4: Execute M72 to activate the manual- offset function
Step 5: Switch the mode to Automatic MODE
Step 6: Use the handwheel to switch the axis to the U axis. Start moving the coordinates to the deviation point. Here the machine coordinate and the relative coordinate have been at variance. In the meantime, the offset operation for the U axis has been completed which means that the axial offset is done by now.
Step 7: If any further adjustment is required, please repeat Step 5 to 6.
Step 8: When there is no more need to adjust the position, please execute M73 to dismiss the manual offset function.

Note:
All HBM models with FANUC 31iB/32iBare applied with FANUC software S637 now and through PLC to update the new version of HBM1-C2 (Specified to Servo type facing head).Before the offset operation, the system shows the same value of relative coordinate, absolute coordinate and machine coordinate. The value of the relative and machine coordinates have been changed after the manual-offset operation has been done.

Before the offset operation



After the offset operation



Note:
When reboot the system the manual-offset function will be dismissed. However, the original offset value was stored in the system. To modify the offset value, one needs to restart M72 according to steps above.

Longshan Temple, Lukang Photo by Shin Huang

Enchanting Chinese Calligraphy

The Master Calligrapher – Wu, Dong-Yuan

Opened in 1784, Lukang a.k.a. the Deer Harbour, was once the most commercially-centered hub in central Taiwan that traded with China, in addition to Fucheng(Tainan, S. Taiwan) and Manga(Taipei, N. Taiwan). It has now become the most visited historical town for tourists from around the world. Not to mention Lady Gaga who also came visit and was fascinated by the traditional lantern-making. The rich cultural activities have been passed down from generation to generation since the Qing dynasty. Today, Lukang tops the world by having the most densely-populated Chinese calligraphy learners in town. Many travel all the way to discover the legend of this Chinese traditional treasure hidden in old temples and streets. "The Challenger" is honored with the opportunity to interview Lukang's most prestigious Chinese calligrapher — Wu, Dong-Yuan.

Profile

Wu, Dong-Yuan, born in 1928, started his journey in Chinese calligraphy at age 8. With great passion for Han literature and poems, he followed the guidance from his uncle and built a solid foundation on Han culture since then. Being a full-time calligraphy artist, Master Wu devoted 4 to 5 hours doing calligraphy on a daily basis for decades. Earlier in life, he engaged himself in various culture scenes especially in poet's societies. Today, he mainly works at home and those who admire his work would call upon him. Much to his delight, his son, Wu Zhao-Chang had followed in his footsteps and is now an active calligrapher and poet. Both of them have won the first prize in National Contest of Art Exhibition calligraphy category. However, Master Wu is a humble man and has always kept a low profile. To him, studying literature and calligraphy is the greatest gift of all. Last year in 2015, Master Wu celebrated his 88th birthday by exhibiting his calligraphy works at Lukang Culture Centre. It was a sensation in the Taiwanese culture scene. Master Wu has been invited to take part in the Changhua Artists Marathon Exhibition. His next exhibition will take place at Changhua Arts Museum from 2016/12/21-2016/12/25.

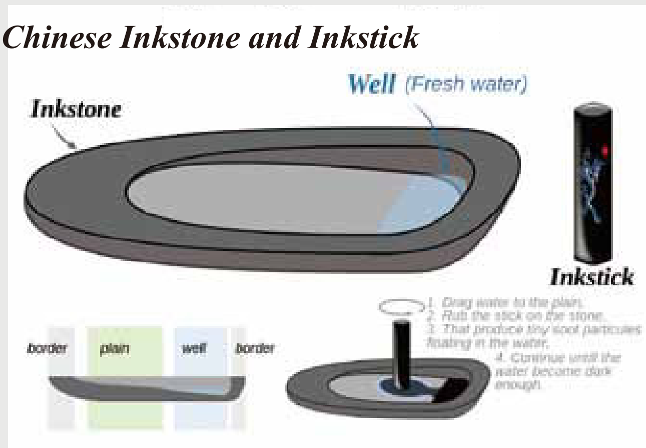
Master Wu, Dong-Yuan with the name of Buffalo, "達佛羅"

Master Wu(left) with his son(right), Wu Zhao-Chang performing at Lukang Culture Centre, 2015 Photo by Shin Huang

The Challenger had the great pleasure to interview Master Wu at the historical Lukang and to experience Master Wu's illustrious calligraphic skills.

Q1. What makes you step into the world of Chinese calligraphy?

In the past, every family had their own family name composed with 4 Chinese characters. They carved the name into wooden tablet in calligraphy and hung it at the entrance. I always enjoy studying them, observing the different calligraphy styles. I was obsessed with the beauty of calligraphy since then. During the Japanese colonial era, there was the shortage of writing paper and materials due to the stoppage of Lukang's cross-strait trading with China. However, my brother always traveled to Fuchen(Tainan, S. Taiwan) and brought back paper and materials. So I was able to practice my calligraphy skills without issues.



Chinese Inkstone and Inkstick

Photo by Yug - Own work, CC BY-SA 3.0, Photo from https://commons.wikimedia.org/w/index.php?curid=4655786

Q3. Who are the ancient calligraphers that influenced you the most?

Yan Zhe-Qing, Wang Xi-Zhi, Wang Xian-Zhi, O Yang-Sheun, Liu Gong-Chuan, Mi Fu, etc. Yan style is more well-rounded whilst Mi's is more slim. It is important to hold the brush upright and focus force on the center point. The characters done with the brush upright are more classic and worth longer appreciation.

"Calligraphy is sheer life experienced through energy in motion that is registered as traces on silk or paper, with time and rhythm in shifting space its main ingredients." – Stanley Baker

Master Wu's work with 4 different scripts

Q4. There are 8 different scripts in the Chinese language. What is your most frequently used script? Is there a way to understand other scripts we do not use nowadays?

My most frequently used script is Regular Script, because people can read and understand the meaning of work more easily and appreciate it. There is no shortcut in Chinese language learning, one must spend time and develop interests to recognize characters.

Q5. Regarding the modernization on Chinese calligraphy, people tend to create visual effect by changing the look of characters combining various methods. What is your opinion on this change?

Changing is good, however, a good work depends not on the look but on the high spirit of the work itself. The change must have an origin as well. It should acquire certain rules instead of changing at random. A calligrapher must take time to practice calligraphy after the recognized classical works. One must acquire inner force to perform a good piece of work.

Q6. Chinese calligraphy is regarded as the essence of Chinese culture. Lukang is considered the town with most densely-populated calligraphy learners in the world. What is your expectation on the future of Lukang's rich calligraphy culture?

I hope we can create a stele forest in Lukang like the Xi-an Beilin Museum in China. Whenever I visit Taichung, I am always delighted to stroll around the stele forest at National Museum of Fine Arts. I enjoy observing these ancient Chinese calligraphy works of the great masters.

A few years ago, we made one at WenKai Elementary School. However, it is a bit too small to be noticed. Due to the lack of finance support, we haven't managed to create a proper stele forest at Lukang. I really hope that we can make it happen one day for the calligraphy culture preservation and for people to enjoy the beauty of calligraphy.

Q7. What is the biggest influence that Chinese calligraphy has had to you? How do you manage to stay healthy and active at the age of 90?

There is no obvious influence. But through practicing Chinese calligraphy, it purifies the body, mind and soul. I have little distracting thoughts since I spend a great amount of time on practicing and reading. Calligraphy-writing is a great way to relax and bring peace to the inner mind. It is a symbol of oneself and is a way of expressing the artist's mind to others. Poems should be created spontaneously. The combination of calligraphy and poem are gentle and placid without exaggerated embellishment. There is no secret to attain longevity, just stay away from fame and wealth.

At the end of the interview, Master Wu Dong-Yuan created a piece of work with the Chinese character of Da-Fo-Luo which is the name of Buffalo Machinery in Chinese. It was a meditative moment for us all. Art Virtue indicted, "For Chinese calligraphers, literally, we are "writing (not painting)" the characters with brushes made of animal hairs. Technically, we are "carving" the characters to some extent by using the brush tip to mimic a knife. Mentally, we are "projecting" the characters - that's why Chinese calligraphy is also called the "picture of soul" or "heart painting" or "mind image."

益文齋-"Yi-Wen-Zhai" name of workshop which was written by Master Wu. Calligraphy and poem of Spring Festival couplets on the front door of workshop also by Master Wu.

Master Wu writing "達佛羅", the name of Buffalo,

People

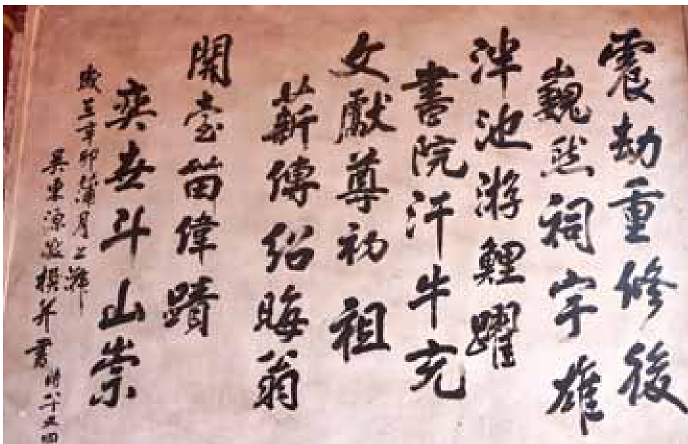
The Art of Calligraphy

Chinese calligraphy is deeply rooted in Lukang. It has become the life of the inhabitants. People here carry the responsibility to enrich their life through works such as lantern-making, sculpturing, painting and so forth. Once visited, you can feel the spirit in the air.

Ancient calligraphy work of Longshan Temple, Regular script(left), Semi-cursive script(right)

Reference:

http://www.art-virtue.com/introduction/5- longevity.htm
https://zh.wikipedia.org/wiki/%E7%B1%B3%E8%8A%BE
https://en.wikipedia.org/wiki/Chinese_calligraphy
https://zh.wikipedia.org/wiki/%E9%A2%9C%E7%9C%9F%E5%8D%BF



Master Wu's semi-cursive script at Wenkai Academy

Regular script calligraphy at Jingmen Temple.

Small seal script by Mr. Yu, Zu-He at Wenkai Academy

Master Wu's son writing Master Wu's poem with clerical style at Wenkai Academy

Master Wu's 88-year-old exhibition at Lukang Culture Center, 2015 Photo by Shin Huang

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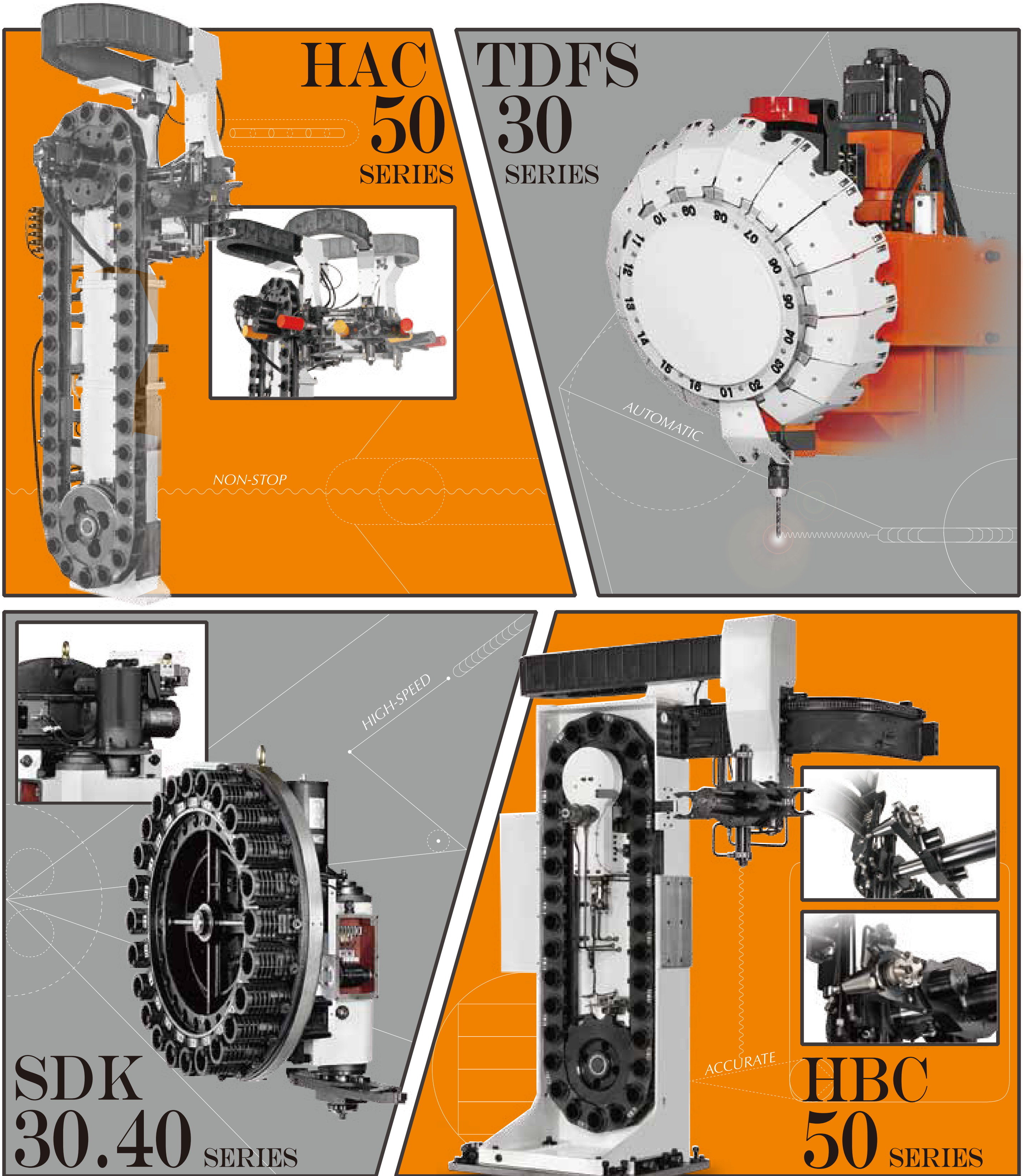

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