ASIGURAREA CALITĂȚII – QUALITY ASSURANCE

CUPRINS – CONTENTS

Asigurarea Calităţii – Quality Assurance, ISSN 1224–5410
Vol. XVI, Issue 62, April-June 2010
Pages 2 - 9

Design of Experiments with a Ranking Response: Analysis of the Result with the Mann-Whitney Statistic

Maurice PILLET[1], Emmanuel DUCLOS[2], Magali PRALUS[1]
[1] University of Savoy – SYMME – Polytech'Savoie, Annecy, France; [2] EDC Conseil Formation;
maurice.pillet@univ-savoie.fr

Abstract
Product quality very often depends on organoleptic characters that are difficult to measure. As examples, let us look at the visual aspect of a vehicle dashboard, the flavour of a product, etc. During the process optimization, it's very difficult to use such responses to analyse an experimental design, because of the lack of information contained in this type of response and the problems of repeatability and reproducibility inherent in these characters. However, if it is not possible for an appraiser to provide a measure in a continuous scale, it is easier to compare various objects. In this article, we propose to use this classification to calculate a rank variable (Mann-Whitney statistic) which will be used as a numeric variable in order to exploit the results of an experimental design. Several strategies will be presented and illustrated with industrial examples

Keywords: Mann-Whitney statistic, sensory perception defects, sensory analysis, design of experiments.

References:

[1] ISO 13299:2003, Sensory analysis — Methodology — General guidance for establishing a sensory profile, 2003.
[2] F. Depledt, Evaluation sensorielle: Manuel méthodologique, Tech. & Doc., Lavoisier, 1998.
[3] M. C. Gacula, Descriptive sensory analysis in practice, Wiley-Blackwell, 1997.
[4] M. C. Meilgaard, G.V. Civille and B.T. Carr, Sensory evaluation techniques, 3rd ed. CRC. CRC Press, London, 1999.
[5] M. O'Mahony, Sensory evaluation of food, Statistical methods and procedures, Marcel Dekker, 1986.
[6] M. G. Kendall, A New Measure of Rank Correlation, Biometrika, 30, pp. 81-93, 1938.
[7] H. Jaroslav, S. Zbynek and K. Pranab, Theory of Rank Tests, 2nd ed., Academic Press, 1999.
[8] E. L. Lehmann, Nonparametrics: Statistical methods based on ranks, San Francisco: Holden-Day, 1975.
[9] C. Spearman, The Proof and Measurement of Association Between Two Things, American Journal of Psychology, 15, pp. 72-101, 1904.
[10] M. Kendall and J.D. Gibbons, Rank correlation methods, 5th ed, Ed. Edward Arnold, 1990.
[11] S. Yue, P. Pilon and G. Cavadias, Power of the Mann-Kendall and Spearman's rho tests for detecting monotonic trends in hydrological series, Journal of Hydrology, 259, pp. 254-271, 2002.
[12] W. W. Daniel, Applied Nonparametric Statistics, Boston: PWS-Kent, 2nd edition, 1990.
[13] G. E. Noether, Why Kendall Tau?, The best of teaching statistics, pp. 41-43, 1986.

Asigurarea Calităţii – Quality Assurance, ISSN 1224–5410
Vol. XVI, Issue 62, April-June 2010
Pages 2 - 9

[14] M. Alvo and P. Cabilio, Average rank correlation statistics in the presence of ties, Communications in Statistics – Theory and Methods, 14, 1985.
[15] R. A. Fisher, Statistical methods for research workers, Oliver & Boyd, Edinburgh, 1934.
[16] Ph. Caperaa and B. Van Cutsem, Méthodes et modèles en statistiques non paramétriques Exposé fondamental, Presse de l'université Laval, DUNOD, 1988.
[17] D. W. Zimmerman, A note on homogeneity of variance of scores and ranks, Journal of Experimental Education, vol. 64, pp. 351-362, 1996.
[18] D. W. Zimmerman and B. D. Zumbo, Rank transformations and the power of the Student t test and Welch t' test for nonnormal populations with unequal variances, Canadian Journal of Experimental Psychology, vol. 47, pp. 523-539, 1993.
[19] R. H. Randles and D. A. Wolfe, Introduction to the theory of nonparametric statistics, New York: Wiley, 1979.

Asigurarea Calităţii – Quality Assurance, ISSN 1224–5410
Vol. XVI, Issue 62, April-June 2010
Pages 10 - 17

Some Mechanical and Metallurgical Aspects of the Degradation in Interconnects

Michel IGNAT
CNRS, INP Grenoble, LTPCM, 38402 Saint Martin d'Hères, France
michel.ignat@inpg.fr

Abstract
The mechanical and metallurgical characteristics of PbSn solder joints used as interconnects in Multi-Chip Modules (flip-chips) are examined through mechanical testing (in tension and in shear) and by thermal treatments. The influence of the solder pad metallurgies (Au and Ni) upon the behaviour of the solder joints is examined. Fatigue testing performed upon flipchip samples demonstrates the difference in mechanical comportment between Pb40Sn60 and Pb95Sn5 solders, as well as the influence of Au upon the fatigue life. A model for predicting fatigue life is put forward.

Keywords: Reliability, fatigue testing, degradation, metallurgical characteristics, of PbSn solder joints, Multi- Chip Modules.

References:

[1] R. Satoh, K. Arakawa, M. Harada and K. Matsui, Thermal fatigue life of Pb-Sn alloys interconnections, IEEE Trans. CHMT., Vol.14, 1, 1991, pp. 224-232.
[2] D.R. Frear, D. Grivas, and J.W. Morris Jr., A microstructural study of the thermal fatigue failures of 60Sn-40Pb solder joints, J. Electron. Mats., vol. 17, 1988, pp.171-180.
[3] L.S. Goldman, R.D. Herdzik, N.G. Koopman, and V.C. Marcotte, IEEE Trans., vol. PHP-13, 3, 1977, pp.194-201.
[4] A. Soper, Contribution à l'étude mécanique des interconnexions par microbilles, Docteur Ingénieur thesis INP Grenoble, 1997.
[5] G. Pozza, G. Parat, M. Ignat, Mechanical behaviour of two sorts of MCM structures, MRS Proceedings, Vol. 390, 1996, pp.153-159.
[6] M.F. Ashby and D.R.H. Jones, Matériaux 1, Propriétés et Applications, Dunod, Paris, 1991.
[7] J. Lemaitre and J.L. Chaboche, Mécanique des Matériaux Solides, Ed. Dunod, Paris, 1985.
[8] R. Darveaux and K. Banerji, Constitutive relations for tin-based solder joints, IEE Trans. CHMT., vol.15, 6, 1992, pp.1013-1024.
[9] C. Laird and G.C. Smith, Phil. Mag., Vol.7, 77, 1962, p. 847.
[10] W.G. Bader, Dissolution of Au, Ag, Pt, Cu and Ni in a molten tin-lead solder, Weld. J., Vol. 40, 1969, pp. 551-557.
[11] G.D. O'Clock, M.S. Peters, J.R. Pater, G.A. Kleese and R.V. Martini, Pb-Sn alloy microstructure: potential reliability indicator for interconnects, IEEE Trans. CHMT., Vol. 10, 1, 1987, pp. 82-88.
[12] K.J. Puttlitz, Preparation, structure, and fracture modes of Pb-Sn and Pb-In terminated flip-chips attached to gold capped microsockets, IEEE Trans. CHMT., Vol. 13, 4, 1990, pp. 647-655.
[13] P. Rabbe, La fatigue des matériaux et des structures, Ed. J.P. Bailon Coll. Hermes, Paris, 1980.
[14] S. Suresh, Fatigue of materials, Ed. Cambridge, Univ. Press. UK, 1991.
[15] R.C. Weinbel, J.K. Tien, R.A. Pollak, S.K. Kang, J. Mater Sci., 22, 11, 1987, pp. 3901-3906.

Asigurarea Calităţii – Quality Assurance, ISSN 1224–5410
Vol. XVI, Issue 62, April-June 2010
Pages 10 - 17

[16] I. Dewolf, G. Pozza, K. Pinardi, D.J. Howard, M. Ignat, S. Jain, H., Maes „experimental validation of mechanical stress models by microRaman Spectroscopy“, Microelectron. Reliab., Vol. 136, 11-12, 1996, pp. 1751-1754.
[17] I. Dewolf, M. Ignat, G. Pozza, L. Maniguet, Analisis of local mechanical stresses in and near tungsten lines on silicon substrate, J. Appl. Phys., Vol. 85, 9, 1999, pp. 1-9.

Asigurarea Calităţii – Quality Assurance, ISSN 1224–5410
Vol. XVI, Issue 62, April-June 2010
Pages 18 - 23

MEMS and Reliability

Titu-Marius I. BĂJENESCU
C. F. C., La Conversion, Switzerland
tmbajenesco@bluewin.ch

Abstract
MEMS technology could possibly enable in the next 10-15 years various space mission applications – a driver in future MEMS development; the microsystem is a „smart“ sensor, also able to actuate. The number of microscale sensors in our environment is set to increase. The fabrication techniques are essentially two dimensional while the third dimension is created by layering. MEMS components by their very nature have different and unique failure mechanisms than their macroscopic counterparts. In MEMS, there are several failure mechanisms that have been found to be the primary sources of failure within devices. In comparison to electronic circuits, these failure mechanisms are neither well understood nor easy to accelerate for life testing. This paper is intended to inform the non-MEMS technologists, researchers and decision makers about some not yet solved problems.

Keywords: MEMS, NEMS, reliability, failure modes and mechanisms, packaging, CNT-FETs, RF-MEMS.

References:

[1] Băjenescu, T.-M. I., and M. Bâzu, Component Reliability for Electronic Systems, Chapter 15, Boston and London: Artech House, 2009.
[2] Walraven, J. A., „Failure Mechanisms in MEMS,“ Procee-dings of IEEE International Test Conference, 2003, pp. 828-833.
[3] Hsu, T.-R., „Introduction to Reliability in MEMS Packaging“, International Symposium for Testing & Failure Analysis, San Jose, CA, USA, November 5, 2007.
[4] Tanner, D. M., and M. T. Dugger, „Wear Mechanisms in a Reliability Methodology“, SPIE Proceedings, Vol. 4980 (2003), pp. 22-40.
[5] De Pasquale, G., A. Somà, and A. Ballestra, „Mechanical Fatigue Analysis of Gold Microbeams for RF-MEMS Applications by Pull-in Voltage Monitoring“, Analog Integrated Circuits and Signal Processing,March 2009, http://www.springerlink.com/content/j2414382p4407849/.
[6] Alsem, D. H., et al., „Fatigue Failure in Thin-Film Polycrystalline Silicon is Due to Subcritical Cracking Within the Oxide Layer“, Applied Physics Letters, Vol. 86 (2005), pp. 041914-1 to 041914-3, http://www.lbl.gov/ritchie/Library/PDF/DaanHein-APL.pdf.
[7] Bhushan, Bh., (ed.), Nanotechnology, New York: Springer, 2006.
[8] Rotenberg, X., „RF MEMS design and reliability analysis“, Tutorial T3, ESREF 2008.
[9] Patton, S. T., and J. S. Zabinski, „Failure Mechanisms of DC and Capacitive RF MEMS Switches“, Proceedings of SPIE, Vol. 6111 (2006).
[10] Okigawa, Y., et al., „Electrical Properties of Carbon Nanotube Field-Effect Transistors with Multiple Channels Measured by Scanning Gate Microscopy“, Japanese Journal of Applied Physics, 49 (2010) 02BD02.
[11] Desmulliez, M., and S. Lavu, „Failures Modes and Effects of Failures in MEMS“, http://www.microreliability2007.com/cms/front_content.php?idcat=30&idart=36.

Asigurarea Calităţii – Quality Assurance, ISSN 1224–5410
Vol. XVI, Issue 62, April-June 2010
Pages 24 - 32

Application of Taguchi Method in Optimization of Centrifugal Finishing Process Parameters

Suraj S. RANE[1], A. SRIVIDYA[2], A.K. VERMA[3]
[1] Department of Mechanical Engineering, Padre Conceicao College of Engineering, Goa INDIA;
[2] Department of Civil Engineering, Indian Institute of Technology Bombay, Mumbai, INDIA;
[3] Department of Electrical Engineering, Indian Institute of Technology Bombay, Mumbai, INDIA
rsurajs@yahoo.com

Abstract
This study investigates the factors that optimize the surface finish of turbine blades on the centrifugal finishing machine. Taguchi method has been employed to determine the optimal levels of process parameters which affect surface finish. The factors identified in the brainstorming session are type of abrasive, water level and operation time. Orthogonal array decided by number of factors and their levels, was used to conduct the experiment. Signal-to-noise ratio and analysis of variance were then calculated to provide the statistical confidence of the experiment. The result of this study is that the surface finish of the blades improved considerably which led to scrap reduction. Also there was a reduction achieved in operation time per blade from 25 minutes to 3 minutes.

Keywords: Centrifugal finishing, Taguchi methods, surface finish, turbine blades.

References:

[1] G. Taguchi, S. Chowdhary, S. Taguchi, Robust Engineering, McGraw Hill, New York, 2000.
[2] O. Hasan, T. Erzurumlu, M. Col, A study of the Taguchi optimization method for surface roughness in finish milling of mold surfaces, Int. J. Adv. Manuf. Technol., 28, 2006, pp. 694-700.
[3] C. Lin, L. Yang, H. Chow, Study of magnetic abrasive finishing in free-form surface operations using the Taguchi method, Int. J. Adv. Manuf. Technol., 34, 2007, pp. 122-130.
[4] E. Bagci, S. Aykut, A study of Taguchi optimization method for identifying optimum surface roughness in CNC face milling of cobalt-based alloy (stellite 6), Int. J. Adv. Manuf. Technol., 29, 2006, pp. 940-947.
[5] M. Kurt, E. Bagci, Y. Kaynak, Application of Taguchi methods in the optimization of cutting parameters for surface finish and hole diamtere accuracy in dry drilling processes, Int. J. Adv. Manuf. Technol., 40, 2009, pp. 458-469.
[6] K. Palanikumar, Application of Taguchi and response surface methodologies for surface roughness in machining glass fiber reinforced plastics by PCD tooling, Int. J. Adv. Manuf. Technol., 36, 2008, pp. 19-27.
[7] H. Liao, J. Shie, Yang Y., Applications of Taguchi and design of experiments methods in optimization of chemical mechanical polishing process parameters, Int. J. Adv. Manuf. Technol., 38, 2008, pp. 674-682.

Asigurarea Calităţii – Quality Assurance, ISSN 1224–5410
Vol. XVI, Issue 62, April-June 2010
Pages 24 - 32

[8] V. N. Gaitonde, S. R. Karnik, B. T. Achyutha, B. Siddeswarappa, Methodology of Taguchi optimization for multiobjective drilling problem to minimize burr size, Int. J. Adv. Manuf. Technol., 34, 2007, pp. 1-8.
[9] C. Manoharan, V. P. Arunachalam, Dynamic analysis of hydropdynamic bearing performance in ic engines by using Taguchi techniques and Response Surface Methodology (RSM), Int. J. Adv. Manuf. Technol., 36, 2008, pp. 1061-1071.
[10] J. C. Chen, Y. Li, R. A.Cox, Taguchi-based Six Sigma approach to optimize plasma cuttinh process: an industrial case study, Int. J. Adv. Manuf. Technol., 41, 2009, pp. 760-769.
[11] A. Manna, B. Bhattacharyya, Investigation for optimal parametric combination for achieving better surface finish during turning of Al /SiC-MMC, Int. J. Adv. Manuf. Technol., 23, 2004, pp. 658-665.
[12] M. Wang, H. Wu, S.L. Chung, Optimization of experimental conditions based on Taguchi robust design for the preparation of nano-sized TiO2 particles by solution combustion method, J. Porous Mater., 13, 2006, pp. 307-314.
[13] R. Jeyapaul, P. Shahabudeen, K. Krishnaiah, Simultaneous optimization of multi-response problems in the Taguchi method using genetic algorithm, Int. J. Adv. Manuf. Technol., 30, 2006, pp. 870-878.
[14] ASM Metal Handbook, Vol. 5 Surface Engineering, 1994.