Assembly Yield Prediction of PoP Packages by Advanced Uncertainty Propagation Analysis

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Ever-increasing demand in development cycle time reduction often causes time required for manufacturing verification (or stable yield) to be undesirably long (sometimes even longer than development time itself). One of the most critical reasons is “uncertainty propagation” during manufacturing, caused by the margins and variations of design and material solutions at the product development stage.

The probability density function (PDF) of the system response resulted from the propagated uncertainty can be assessed by the conventional Monte Carlo simulation technique (random sampling) and/or the response surface approximation techniques. The former usually offers the most accurate results if an extremely large number of sampling is utilized. Yet, this becomes impractical for non-linear problems due to excessive computational cost even with the most advanced computing power. The latter with Monte Carlo sampling can be effective for problems with a few input variables, but it also becomes impractical due to the well-known “curse of dimensionality” when problems with numerous input variables are to be considered. The approximate integration methods are relatively new but they have a distinct advantage over the other methods. The computational cost increases only “additively” with the increased number of variables since the uncertainty propagation is estimated by the additive decomposition of a multiple-dimensional integration.

In this seminar, the advanced approximate integration methods including the eigenvector dimension reduction (EDR) method are presented. After describing the mathematical frame work, the application to a real manufacturing problem with 12 input variables is presented. The accuracy of the method in conjunction with the effectiveness is discussed by comparing the results with the Monte Carlo simulation.

About the speaker: Dr. Bongtae Han is Keystone Professor of Engineering and APT Chair of the Mechanical Engineering Department of the University of Maryland; and is currently directing the LOMSS (Laboratory for Optomechanics and Micro/nano Semiconductor/Photonics Systems) of CALCE (Center for Advanced Life Cycle Engineering).

Dr. Han has co-authored a text book entitled "High Sensitivity Moiré: Experimental Analysis for Mechanics and Materials", Springer-Verlag (1997) and edited two books. He has published 12 book chapters and over 250 journal and conference papers in the field of microelectronics, photonics and experimental mechanics. He holds 2 US patents and 4 invention disclosures.

Dr. Han received the IBM Excellence Award for Outstanding Technical Achievements in 1994. He was a recipient of the 2002 Society for Experimental Mechanics (SEM) Brewer Award for his contributions to development of photomechanics tools used in semiconductor packaging. Most recently, he was named the 2016 American Society of Mechanical Engineering (ASME) Mechanics Award winner in Electronic and Photonic Packaging Division for his contributions to structural mechanics of electronic systems. His publication awards include (1) the Year 2004 Best Paper Award of the IEEE Transactions on Components and Packaging Technologies, (2) the Gold Award (best paper in the Analysis and Simulation session) of the 1st Samsung Technical Conference in 2004 and (3) the Year 2015 Best Paper Award of the 16th International Conference on Electronic Packaging Technology (ICEPT 2015). His contributions to an innovative 1,500-face lumen LED luminaire, jointly developed with GE, have been recognized in a Press Release (Oct. 21, 2010, MarketWatch.com, The Wall Street Journal). He served as an Associate Technical Editor for Experimental Mechanics, from 1999 to 2001, and also served as an Associate Technical Editor for Journal of Electronic Packaging, Transaction of the ASME from 2003 to 2012.

He was elected a Fellow of the SEM and the ASME in 2006 and 2007, respectively.