STANDARD DEVELOPMENT COMMITTEE (SDCOM)
WORKING GROUP

IEEE STANDARDS PROJECT 1597

P1597.1: Standard for the Validation of CEM Computer Modeling & Simulation
P1597.2: Recommended Practice for CEM Computer M&S Applications

MEETING MINUTES

Date: Monday, 13 August 2001

Place: Palais des Congres, Montreal, Canada, Room 402C

Time: 6:00 to 9:00 PM

Attendees/Membership List

Name	Company/Address	E-mail/Phone	Meetings Attended
Andy Drozd **Chair**	ANDRO Computational Solutions Rome, NY	andro1@aol.com (877) 334-1188	8/13/01
Dr. Bruce Archambeault **Vice Chair**	IBM, Research Triangle Park Raleigh, NC	barch@us.ibm.com (919) 486-0120	8/13/01
Dr. Maqsood Mohammed **Secretary**	Sverdrup Technologies/TEAS Eglin AFB, FL	maqsood@ieee.org (850) 729-6115	8/13/01
Stephen Berger Chair, EMC-S SDCom	TEM Consulting Georgetown, TX	stephen.berger@ieee.org (512) 864-3365	8/13/01
Dr. Toshihiko Matsuura	Fujitsu Japan	matt@strad.se.fujitsu.co.jp +81-43-299-3240	8/13/01
Dr. Ryuji Koga	Okayama University Japan	koga@cne.okayama-u.ac.jp +81-86-251-8135	8/13/01
Dr. Osami Wada	Okayama University Japan	wada@cne.okayama-u.ac.jp +81-86-251-8137	8/13/01
Dr. Jose Basterrechea	University of Cantabria Spain	basterrj@unican.es jose@unican.es +34-942-201559	8/13/01
Dr. Fernando Las-Heras	Universidad De Oviedo Spain	flasheras@tsc.uniovi.es +34-985-182541	8/13/01
Colin Brench	Compaq Computer Corporation Marlborough, MA	colin.brench@compaq.com (508) 467-4454	8/13/01
Dr. David Johns	Flowmerics, Ltd. Southborough, MA	davidj@flowmerics.com (508) 357-2012	8/13/01
Dr. Al Ruehli	IBM, Thomas J. Watson Research Center, Yorktown Heights, NY	ruehli@us.ibm.com (914) 945-1592	8/13/01
Dheena Moongilan	Lucent Technologies NJ	moongilan@lucent.com (732) 332-6003	8/13/01
Tim Harrington	FCC Laboratory Division Columbia, MD	teharrington@aol.com THARRING@fcc.gov (301) 362-3000/3039	8/13/01
Dr. Zhi L. Wang	Okayama University Japan	zlwang@cne.okayama-u.ac.jp +81-86-255-8137	8/13/01
Tetsushi Watanabe	Okayama University Japan	watanabe@okakogi.go.jp +81-86-286-9600	8/13/01

Introduction

This was the first meeting of the Working Group (WG) on behalf of the P1597.1 and P1597.2 projects held in conjunction with the 2001 IEEE International Symposium on EMC in Montreal. This was actually an ad hoc meeting for the two projects, which at the time, were pending official approval by the IEEE New Standards Committee (NESCOM). The projects were officially approved and authorized by NESCOM during their review meeting held during the week of 9 September.

Summary

The meeting was called to order on 13 August 2001 at 6:00 PM at the Montreal Palais des Congres. Andy Drozd, WG Chair led the meeting by reviewing the meeting schedule (Attachment 1) and providing an overview of the Project Authorization Requests (PARs) that were submitted to NESCOM for review (go to *http://grouper.ieee.org/groups/index.html*, PAR Approvals/History). Each project is four (4) years in duration.

The thrust of P1597.1 is to develop a standard for the validation of CEM computer modeling and simulation (M&S) codes in differing applications. The standard will provide a basis for analytical and empirical validation of CEM codes and configurations focusing on several key areas, which include:

- Validation by use of canonical models – This refers to the specification of canonical modeling elements as a function of ensemble parameters (frequency, desired accuracy or fidelity, physics and numerical solution method, etc.).
- Validation by simulation versus measurement - Includes considerations for model- versus measurement-driven uncertainty estimates and relationships.

P1597.1 is intended to guide the validation of CEM application models by developing a methodology that will assist in achieving code-to-code or simulation-to-measurement validations within a consistent level of accuracy. The proposed standard is anticipated to provide a method for validating CEM codes and models across a range of applications and problem categories. This may include various EM phenomena and effects such as scattering, RCS, antenna radiation, radiation hazards and related safety issues (e.g., SCC 34, COMAR), etc.

Comparable work has been accomplished and continues to mature on behalf of other collaborative engineering disciplines such as computational fluid dynamics (CFD), thermal and structural/mechanical engineering. These will also be looked at for guidance and the development of a draft standard.

The scope of the P1597.2 project is to develop a recommended practice for use in CEM computer M&S applications to guide the EMC design of printed circuit boards to large, complex systems. Areas to be addressed include:

- General guidelines for creating CEM models.
- Development of modeling methodologies for small-to-large scale “canonical” systems, platforms or composite models.
- Methodologies for developing and applying collaborative, multi-disciplinary engineering modeling schemes.
- Computation of uncertainty for modeling applications.

The recommended practice will aid modelers and analysts in the selection and application of appropriate M&S methodologies, physics, and solution techniques to achieve accurate results and to complement measurements and EMC design tasks for a wide range of problems. As with the counterpart standard, a significant aspect of computer M&S for CEM/EMC will apply to a wide range of EMC and other EM phenomenology and effects problem categories.

The Chair also discussed the appointment of Dr. Bruce Archambeault as the WG Vice Chair and Dr. Maqsood Mohammed as the WG Secretary. Since both projects have a great deal of commonality, they will be conducted as a single WG effort within approximately the first year of activity. After that, it is anticipated that the projects will split and potentially be headed by a different team of WG officers, although both WG activities may have the same or a similar membership profile.

The membership to date is roughly broken down as follows: Government (≈25%), industry (≈50%), and academia (≈25%). From these, the estimated user/producer/general interest profile is: 100% (code users), 50% (code producers/developers), and 100% (general interest and materielly interested organizations). This represents a reasonably balanced group for balloting purposes.

The most recent version of the *IEEE EMC Society Standards Development Committee Policies and Procedures* will be used as the guidance document for the operation of the WG.

It is anticipated that the WG would meet face to face at least once per year as part of the annual EMC symposia and up to 2-3 additional times per year in conjunction with other symposia, conferences, or review meetings. It was suggested that email correspondence and telecons be periodically arranged, as necessary in lieu of holding actual meetings at selected venues in the event of schedule conflicts or unavailability of a quorum of WG members to participate in person.

Meeting Highlights/Technical Topics and Issues

One of the meeting objectives was to openly solicit ideas, identify core technical issues and concerns, define EMC problem categories, and set the general tone of the WG towards the development and practical application of standards for CEM. In the course of the round table discussions the following key points, issues, and questions were raised:

- The need to establish a working set of standard definitions and terms.
- Defining the fundamental suite of CEM modeling elements that are the building blocks in generating canonical examples and more complex computational models.
    - Use of primitive modeling elements [wires, patches, facets, cylinders, cones, frusta, n-sided plates, spheres, toroids, general parameterized surfaces, non-uniform relational b-splines (NURBs), etc.].
    - Higher-order basis and current expansion functions.
    - Methods for exchanging data or representing it in a “common” format. – (e.g., current practices make it difficult if not impossible to always assure that a fair comparison is made among codes and modeling techniques for a given problem).
    - Use of simple canonical models (sample problems) for validation.

  - Methods for achieving more complex system models as a function of physics, frequency, resolution/accuracy, error tolerance, and other ensemble input parameters.
- Standard format for the modeling of driver circuits [Wada].
- Standard format for modeling antenna feed structures and associated excitation elements [Drozd].
- Interface issues in replacing one tool with another and then running simulation experiments to validate codes (using a given set of input data for a given model and problem type).
- The focus is to develop standards to validate (benchmark) models i.e., establish a methodology to validate a code using a (set of) test cases and accepted benchmarks [Archambeault].
- The importance of defining or establishing the range of validity of CEM codes.
- Scalability of codes to the type or category of EMC problem to be solved.
- Addressing common gridding/meshing issues.
- Techniques for partitioning the CEM problem into layers or regions to isolate the root cause(s) of a modeling problem in a given simulation.
- Give all modelers an opportunity to model things the same way or in a similar manner [Berger].
- Coordination/harmonization with separate efforts to evaluate compliance with FCC guidelines for human exposure to RF electromagnetic fields (simple dipole, helical dipole, lossy sphere w/dipole), and *IEEE Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) in the Human Body due to Wireless Communications Devices - IEEE P1529/D0.0, Draft Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) Associated with the Use of Wireless Handsets - Computational Techniques* prepared by IEEE SCC-34, Subcommittee 2 [Harrington].
- What is the absolute benchmark? How is an absolute benchmark applied to the validation of CEM codes?
- Methods for bounding and bonding (integrating or superimposing) individual parts of a simulation say as a function of geometry region to capture and properly verify specific EM behaviors for a given problem [Brench].
- Considering software validation levels and classes of problems in validating and verifying CEM codes [Mohammed].
- Investigate the full spectrum of CEM physics and modeling elements (primitives), and how CEM codes use these elements to support the physics, and where improvements to increase accuracy could be considered [Drozd].
- The main concern here is on the modeling of surfaces or volumes and less concern on issues related to primitive modeling elements [Ruehli].
- Provide guidelines for calculating computer resource requirements and how computed metrics can help in selecting an appropriate solution approach.
- Other coordination with relevant research and development projects:
  - IEEE EMC-S TC-9 Technical Committee on CEM.

  - Applied Computational Electromagnetics Society (ACES) Challenging Problems (electrically small canonical problems, PC board emissions and susceptibility, etc.).
  - IEEE APS, MTTS, and MS.
  - Electromagnetic Code Consortium (EMCC) (electrically-large problems for RCS, antenna radiation, and EMI)
  - Dr. Herman Singer's benchmark cases.
- A critical issue is parameter sensitivity analysis e.g., quantifying the effects of long vs. short cables across frequency including parasitics, developing bounds on measured trends, and bounding the capabilities of tools for accuracy [Matsuura].
- There is a lack of (well defined) measurement models and one is oftentimes forced to rely only on simulations, which underscores the need for good benchmarks [Matsuura].
- Good simulations can substantiate measurements and vice versa as well as focus attention on simulation and measurement error and controlling error budgets.
- Ensure that the simulation model and measurement are as identical as possible to each other [Mohammed].
- What methods can be used to measure error and properly bound precision and accuracy in a consistent manner?
- Addressing various EM problem classes, categories, or models in different sections of the standard and recommended practice (e.g., PC board emissions and susceptibility, aircraft or automotive vehicle EMI/C, antenna radiation, consumer device specific energy/heat absorption rate, etc. including associated partitioning, packaging, and technology insertion issues) [Johns, Matsuura, Harrington, Archambeault, Drozd].
- The importance of CAD data issues in the modeling and simulation scheme [Johns].
- Assessing the performance of CEM codes in their ability to accurately handle materials [Drozd].
- Focusing WG efforts on behalf of developing a draft outline of the standard and recommended practice in the near term.
- Developing a web page for posting committee materials, meeting notices, etc.

Other Activities/Coordination

Technical feature articles on the new IEEE P1597 project were published in the fall 2001 edition of the EMC-S Newsletter, ACES Newsletter, and the DoD E^3 Bulletin published by the DoD Joint Spectrum Center.

A presentation will be given by Andy Drozd on the IEEE P1597 Project as part of the Minneapolis EMC Symposium Standards Workshop agenda. The workshop is scheduled for Monday, 19 August 2002.

Informal meetings were held with individuals or small groups of current WG and new members during the ACES Conference (19-23 March 2002) and the EMCC Review Meeting (7-11 May 2002) on the P1597 Project. A meeting was also held with Vice Chair Dr. Bruce Archambeault at IBM, RTP, NC on 28 June to review a draft of the CEM Standard outline based on individual inputs received from members during the past several months.

The EMCC Technical Working Group on Benchmarks (TWGB) has expressed an interest in coordinating with the P1597 Project WG. The TWGB may be able to leverage its suite of RCS measurement and CEM code benchmark validation results to assist this cause.

We gained another 5-6 members during the informal meetings and discussions held in Monterey and Albuquerque. The following are some additional comments and points that have been recently raised:

- The problem of accurate CAD input files and conversions to CEM software tools.
- Special attention on the compatibility between industrial codes - may require cooperation with the software manufacturers.
- The combination of two (or more) industrial codes for analysis of a problem by a multistage approach - It would be nice to have one (or more) benchmarks simulated by the multistage approach (there may be interest in the combined use of a CEM code and say a software tool for PCB analysis).
- The problem of validation of numerical results by measured data - What kind of measurement techniques can be used for this purpose, their accuracy and limitations?
- Great idea to arrange on-site demonstrations of EMC computer simulations at exhibitions and conferences (to get analyst's feedback).
- Suggestion of adding benchmarks related to mobile phones and having such industries actively participate in its development.
- Running other benchmarks against a company's software may improve the practical experience base and understanding of the software's strengths and limitations.

STANDARD DEVELOPMENT COMMITTEE
(SDCOM)
WORKING GROUP

Kickoff Meeting: Monday, August 13, 2001

ATTACHMENT 1

P1597 WG MEETING AGENDA

Palais des Congres (Convention Center), Montreal, Canada
4th Floor, Room 402C

6:00 to 9:00 PM
(Food and beverages will be available)

1. Call to Order/Introductions	**Andy Drozd**
2. Review of Agenda	**All**
3. Announcements	**Andy Drozd**
4. Background/Charter/Scope	**Andy Drozd**
-1597.1, *Standard for Validation of CEM Computer M&S*	
-1597.2, *Recommended Practice for CEM Computer M&S Applications*	
5. Key Technical/Technology Issues	**All**
-Primitive Modeling Elements	
-Canonical Bodies	
-Large Complex Systems/Structures	
6. Documentation/Relevant Projects	
-ACES Challenging Problems	**Bruce Archambeault**
-Code Validation	**Maqsood Mohd**
-Existing Benchmarks	
-Standard Interface Data Structures (CFD SIDS)	
-CFD General Notation System" (CGNS)	
7. Other Technical Issues	**All**
-Error Measurement & Control	
-Statistical Techniques	
8. Policies & Procedures	**Andy Drozd**
9. New Business	**All**
10. Adjourn	