



# **DMACE Challenge**

(Digital Manufacturing Analysis, Correlation and Estimation)

## Frequently Asked Questions (FAQs)

October 29, 2010

# 1. General

## *What is DARPA?*

The Defense Advanced Research Projects Agency (DARPA) is the central research and development (R&D) organization for the United States Department of Defense (DoD). DARPA manages and directs selected basic and applied R&D projects for DoD and pursues research and technology where both risk and payoff are very high and where success may provide dramatic advances for traditional and military roles and missions.

## *What is digital manufacturing?*

Digital manufacturing (DM) involves the use of computers and “printers” that create physical components from the direct application of raw materials in accordance with a computer-assisted design (CAD) layout. DM techniques have the potential for the development of components that were previously very difficult or expensive to produce using conventional techniques.

## *What is the DARPA DMACE Challenge?*

Under the Digital Manufacturing Analysis, Correlation and Estimation (DMACE) (pronounced “DEE-mace”) Challenge, DARPA will digitally manufacture several complex structures and then conduct a series of structural load tests. Data from the manufacture and load tests will be posted on the Challenge website, <http://www.DMACE.net>. Participants will be challenged to develop a predictive model that accurately correlates DM machine inputs to output structural test data. Submitted models will be evaluated by their ability to predict the test results of the final DM structures. The participant(s) who submits a model that most accurately predicts the final test results wins the Challenge.

## *Why is DARPA investigating DM applications?*

Manufacturing small quantities of complex system components can be costly and time consuming. DM holds the promise of lowering cost and time, both of which are critical concerns for the complex systems required to support DARPA mission objectives. The Challenge will be used to determine whether predictive correlations exist between DM settings and resultant product structural properties.

## *When will the Challenge occur?*

Data for model development will be released incrementally beginning on or about October 29, 2010, and will continue through December 1, 2010. The final parameter change requiring correlation prediction will be posted via the Challenge website on December 3, 2010. Participants have until 4:30 PM EST December 6, 2010, to submit their prediction for the final structures. During the week of December 6, 2010, the final samples will be tested and the winner announced.

## **2. Eligibility**

### ***Who is eligible to enter the competition?***

The Challenge is open to individuals, and teams of individuals, of all ages. Participants under 18 years of age may be required to obtain the consent of a guardian and/or meet other applicable legal requirements as a prerequisite to accepting the Challenge prize.

DARPA employees and family members, as well as DARPA support contractors and their family members, are ineligible to participate in the Challenge. Similarly, Oak Ridge National Laboratory and U.S. Naval Postgraduate School employees, support contractors, and the dependents thereof who are involved with the design, manufacturing, testing and analysis of DMACE Challenge content or materials are ineligible to participate in the Challenge.

Non-U.S. citizens require a taxpayer identification number (TIN) to receive the prize. A TIN is obtainable upon request from the U.S. Government. Additional information is available on the U.S. Internal Revenue Service website at [www.IRS.gov](http://www.IRS.gov).

### ***Do I have to register to participate?***

Yes. Participants must register on the DMACE Challenge website (<http://www.DMACE.net>) before they submit entries. Registration will open on or about October 29, 2010. Registrants must have a working email address to complete the registration process.

### ***Is collaboration authorized in developing my entry?***

Collaboration is authorized and encouraged for developing your entry.

### ***May a participant be on more than one team?***

Participants may be on more than one team. However, an individual participant or team may not submit more than one entry.

### ***Will DARPA provide funding to solve this Challenge?***

No funding or other monetary assistance (other than the prize to the winner) will be provided.

### ***Can an email address, website or other account include “DARPA” in its name? Can I use the DARPA logo on my website?***

No. DARPA’s name and logo are protected under Federal law, and actions that could constitute trademark infringement or trademark dilution should be avoided. Participants should also avoid actions that might suggest or imply official endorsement by DARPA or the U.S. Government.

***As a team leader, can others join my team after I have registered?***

Yes. When a team registers, it must list a team leader and team name. Team leaders determine the individual participants on their team. The team leader will be the primary point of contact for the team.

### **3. How the DMACE Challenge Works**

***What are the structures that will be manufactured and tested?***

DARPA will digitally manufacture structures composed of metallic and polymer materials. The metallic structures will be hollow mesh spheres. The polymer structures will consist of complex cubes and 2-dimensional test specimens (e.g., coupons). The 2-dimensional test specimens will be used to investigate basic material properties of the polymer. Further information on the materials used to manufacture the structure will be posted to the DMACE Challenge website (<http://www.DMACE.net>).

***How will the structures be tested?***

All DM structures will be tested in accordance with conventionally accepted methods. Three-dimensional structure testing may include, but is not limited to, compressive load testing. The simple 2-dimensional polymer test specimen testing may include, but is not limited to, compressive and tensile load testing. Data from the structural load testing will be provided via the Challenge website.

***What type of models can I use?***

The technique of model development is up to the participants. A model may include fundamentals from one or a combination of mathematical, stochastic, structural finite element or any of the many other available techniques. It is up to the ingenuity and creativity of the participants.

***What information will be provided so I can develop my models?***

Data will be provided for both DM process input settings and the corresponding output structural load testing. Input setting data may include, but is not limited to, device control parameters, material composition, and CAD files. Input setting values will be changed over the course of data collection to provide a robust cross-section of data for model development. Output data may include, but is not limited to structural load test results such as stiffness, strength and displacement data. Data may be provided in a variety of formats, tabular and graphical.

All data sets will be provided on the Challenge website to registered participants.

***In what format will data be provided?***

Data will be provided in International System (SI) units in the form of tables and charts.

***How will the models be evaluated?***

For the final evaluation of participant models, several DM input settings will be changed. These may include one or a combination of, and are not limited to, the device control parameters and the complexity of the structure. For the final test configurations, the DM input settings will be altered to previously undemonstrated conditions. Entrants will be required to develop models for two different structures.

***In what format do participants need to submit their entries?***

Participant entries shall be submitted in SI units. Further details regarding the level of precision will be posted on the Challenge website.

***What is the deadline to submit predictions?***

Entries must be submitted by 4:30 PM EST December 6, 2010.

***Where do I submit my final predictions for the DMACE Challenge?***

Final predictions for the Challenge should be submitted on the DMACE Challenge website.

***What makes a valid entry for the Challenge?***

To be valid, an entry must include the predicted result of the structural test for each component; i.e., there will be a prediction for the metallic material structure and the polymer material structure. In addition, a valid entry must include the models and a brief description of the techniques used in the development of the participant's models.

***How will the final winner be decided for the Challenge?***

The participant with the lowest sample Mahalanobis distance will be declared the winner. The formulation for determining the sample Mahalanobis distance will be disseminated on the DMACE Challenge website.

In the event of two entries with the same result, the entry with the earliest submission time will be declared the winner.

***Who should I contact if I have a question regarding the website, the DMACE Challenge, or the rules?***

Questions should be sent to the DMACE Challenge webmaster at [webmaster@DMACE.net](mailto:webmaster@DMACE.net).

***What social media sites will DARPA use to provide information about the Challenge?***

In addition to the DMACE Challenge website (<http://www.DMACE.net>), DARPA will use Twitter and Facebook to provide information about the Challenge.

***How can I request additional information to develop my model?***

Requests may be sent to the DMACE Challenge webmaster at [webmaster@DMACE.net](mailto:webmaster@DMACE.net). Requests for additional information may also be submitted via Twitter and Facebook where other participants can actively participate in discussion on the subject in question.

***I am having difficulty developing a model to predict one of the two results. Can I submit a prediction for only one of the two test results?***

Entrants may submit an entry for only one of the two structural tests; however the winning entry must have a prediction for both structural tests.

***How many times can I submit an entry to the DMACE challenge?***

Only one submission per team or individual participant is allowed.

***Are automated entries allowed?***

Automated entries are not allowed and will disqualify that participant. Automated entries include all automatic, programmed, robotic, or similar means of entry that are not based on a participant-developed correlation model.

***Are emailed entries authorized?***

Emailed entries are authorized; however, the Challenge website is the preferred method to submit entries.

***How will the winner be announced?***

The winner will be announced via email, an official DARPA news release, and updates on Facebook and Twitter.

***Will the final data results be released so I can see how my model compared to others?***

Final results will be released on the DMACE Challenge website (<http://www.DMACE.net>). Information released to the public will be limited to the individual or team names and final predictions for all entrants.

## **4. Prizes**

***What if multiple entrants submit the same final answer?***

In the event of a tie, the valid entry with the earliest submission will be the winner.

***Can an individual represent a large organization and distribute the prize money to a team?***

Yes.

***Can the prize money be paid to my limited liability corporation rather than to me personally?***

Yes.