

# **USACM Committee on Meshfree Methods**

## ***Background***

Over the past 10 years, the trend in computational mechanics has been to focus on increasingly demanding problems that require the ability to treat large deformations, advanced materials, complex geometry, nonlinear material behavior, discontinuities and singularities. This trend may be seen in the simulation of manufacturing processes such as extrusion where extremely large deformations occur, or in failure prediction where the propagation of arbitrarily complex crack paths is of interest. Although adaptive techniques and remeshing strategies have been developed for these classes of problems, the most viable strategy for dealing with the emerging class of simulation problems is believed to lie in the so-called meshfree methods. These methods eliminate some or all of the traditional mesh-based view of the computational domain and rely on a particle (either Lagrangian or Eulerian) view of the field problem. The interest for this committee is on the emerging role of meshfree methods in the computational mechanics arena.

Meshfree methods are over 20 years old, but have not enjoyed a focused research effort until recently. The relatively recent rebirth of interest in meshfree methods has led to a plethora of methods with a variety of names. SPH (smooth particle hydrodynamics), DEM (diffuse element method), EFG (element free Galerkin), RKPM (reproducing kernel particle method), POU (partition of unity), PUFEM (partition of unity finite element method), MPM (material-point method), HP clouds, MLPG (meshfree local Petrov Galerkin), MLSPPH (moving least squares SPH) and a host of other methods have emerged in the arena of meshfree methods. For the purposes of this committee, all methods that abandon at least some aspect of a traditional grid-based approach in favor of a meshfree view are considered to be in the general class of meshfree methods.

## ***Objectives***

Due to the significant presence that “meshfree” methods have had in the engineering and scientific community, a USACM committee to promote these methods is being proposed. The overall objective for this committee is to help establish the identity of meshfree methods and to pursue opportunities to actively involve academia and industry in this research. The overall and near-term objectives are listed below.

### **Overall Objectives**

- Establish ties to journals for publications
- Establish meshfree program of the US Congress
- Establish meshfree program of the World Congress
- Distribute and share information on meshfree methods
- Provide a focal point for meshfree research and applications. This includes organizing workshops, etc.

## **Specific Near-Term Objectives**

- To advance the knowledge base for meshfree methods and provide a mechanism for the dissemination of research in these methods
- To provide a forum that fosters the sharing and development of meshfree methods in the area of computational mechanics (e.g., computational fluid dynamics and computational solid mechanics).
- To recognize outstanding contributions to the advancement of meshfree methods and applications
- To establish the identity of meshfree methods and to pursue opportunities to actively involve academia and industry to participate in this research

In the long-term, the committee will continue to work towards advancing the knowledge base for meshfree methods and for the dissemination of research in these methods.

## ***Approach***

The rules of operation defined here are based on those of the CONCAM (Committee on Computing in Applied Mechanics).

### **I. Activities**

The primary activity for the meshfree committee is the organization of symposia related to topics in meshfree methods and their application to relevant engineering and scientific problems. Proposals to organize a committee-sponsored symposium can be made by any meshfree committee member. Such proposals should be distributed to the committee members by the organizers at least two years prior to the date of the proposed symposium. Competing or conflicting symposia proposals will be resolved by the committee chair.

The committee also seeks to establish the recognition of individuals in the computational mechanics community through the nomination of individuals for various honors and awards. The committee will accept nominations for recognition from any committee member. Awards ceremonies at relevant conferences will provide the vehicle for recognition of outstanding contributions.

### **II. Meetings**

The meshfree committee should meet once a year at a time and place to be announced by the meshfree committee chair. The minutes of the meetings will be distributed electronically via the world wide web (<http://meshfree.usacm.org>) to all meshfree committee members.

### **III. Communication**

In addition to the annual meshfree committee meetings, an e-mail distribution list ([meshfree@usacm.org](mailto:meshfree@usacm.org)) will be used to keep all committee members informed of important events and activities. Committee information will only be distributed electronically, i.e., via e-mail and the world wide web.

#### IV. General Members

The meshfree committee has two designations for those interested in the committee activities. These are defined as members and friends. Members of the committee are considered to be actively involved in carrying out the meshfree committee's duties, while friends are interested but not currently active.

The list of members and friends will be updated annually by consensus of the meshfree chair and vice-chair. The resulting list of members and friends will be made publicly available on the world wide web.

In order to join the meshfree committee, interested parties are required to attend at least two committee meetings in a two year period and express an interest in participating in the committee activities. Individuals are included as friends of the committee after being nominated, their nomination seconded and approved by acclamation of those in attendance.

#### V. Committee Chair

- **Term:** The committee chair serves a two-year term starting at the end of the US National Congress on Computational Mechanics.
- **Election:** The committee chair is filled by succession. The committee's vice chair becomes the chair.
- **Duties:**
  1. The chair is responsible for calling committee meetings, setting their agenda, and presiding over the meetings.
  2. The chair approves and distributes the minutes of the meeting.
  3. The chair is responsible for all communication with the Applied Mechanics Division (AMD) executive committee (ExeCom), especially the coordination of symposia.

#### VI. Committee Vice-chair

- **Term:** The committee vice chair serves a two-year term starting at the end of the US National Congress on Computational Mechanics. At the end of this term, the vice-chair then becomes the committee chair for an additional two years.
- **Election:** A new vice-chair is elected by a majority of voting committee members. This election is conducted by the outgoing vice-chair by distributing a vice-chair ballot to the committee membership, collecting the votes and announcing the vice-chair elect. Nominations for vice-chair are solicited at the US National Congress on Computational Mechanics. Nominations must be seconded and those nominated must be willing to serve as vice-chair and chair (a total of 4 years) before their name can be included on the ballot.
- **Duties:**
  1. Conduct the election of the new vice-chair.
  2. Preside over the activities of the meshfree honors sub-committee
  3. Responsible for recording the committee's meetings.
  4. Responsible for maintaining a list of meshfree committee members.

5. Responsible for the coordination of all symposia to be held during the vice-chair's eventual term a chair. Since proposals for the committee sponsored symposia originate two years prior to the date of the symposia, the vice-chair starts, and maintains, responsibility for all symposia to be held during the vice-chair's eventual term of services as the meshfree committee chair.