主　题:	paper1047 decision
发件人:	chairs-pg2016 　　2016-7-21 1:36:50
收件人:	feizhu

Dear Fei Zhu,

Your paper:
----
paper1047
----
has been recommend for accept with a major revision. This means that it is *not being* accepted to be presented at Pacific Graphcs 2016, however, based on the merit of your submission, the Programme Committee has recommended your paper for revision and submission to the journal Computer Graphics Forum (CGF).

Please find attached details indicating required revisions to your paper suggested by the referees. Should you choose to submit your paper to CGF, the reviews for your PG2016 submission will be used as the first cycle of referee reports for the journal (decision category: resubmit with major revisions). This amounts to a fast track through the CGF review procedure.

Only a very small number of PG2016 submissions are offered this opportunity. Your resubmission would only undergo a second journal review cycle (the outcome of the second review cycle will then be either "accept", "probably accept after minor revisions" or "reject", no further "major revision" cycle is then possible). The revised version of your paper would be sent preferably to some of the original reviewers.

Consequently, should you choose to submit your manuscript to CGF, you should make the changes requested by the referees. The re-submission must also include a detailed revision report describing how you addressed the reviewer comments. The following time line applies:

August 10, 2016: authors indicate if they want to re-submit a major revision to CGF (e-mail to minchencgf@gmail.com or hao.r.zhang@gmail.com)

November 10: submission of major revision. CGF Editors will do their best to finalize the review process within three months. However, if you submit the revision earlier, we will start the second review cycle right after submission. Please upload your fast track manuscript and revision report through ScholarOne Manuscripts: http://mc.manuscriptcentral.com/cgf Select as manuscript type "Major Revision from PG Symposium".

In case of further questions, contact the journal's editors Hao (Richard) Zhang hao.r.zhang@gmail.com and Min Chen minchencgf@gmail.com

We thank you for submitting your work to Pacific Graphics and we hope that you will still consider attending Pacific Graphics which takes place

in Okinawa, Japan, during October 11-14, 2016.
https://indico.oist.jp/indico/event/0/

Sincerely,

PG 2016 Program co-chairs

Eitan Grinspun Columbia University
Bernd Bickel IST Austria
Yoshinori Dobashi Hokkaido University

==
Reviews
==

-------------------- Chair Decision --------------------

accept with major changes (major revision for CGF--regular issue)

-------------------- Summary Review --------------------

Congratulations! After a thorough discussion, this paper has been accepted to CGF with major revisions. Reviewers all agree that the technique introduced in the paper is novel, practical, and could have great impact in computer graphics. Reviewer's main concern about this method is its validation, requiring more comparisons to demonstrate its benefits against other existing approaches for simulating fracture.

We would like to ask the authors to address the following main issues in the revision:
- Demonstrate the benefit of the method by comparing with other existing fracture algorithms (OH99, HJST13, or LBC*14), in particular, provide examples to show how this approach improves the handling of crack tips;
- Show more complex examples for FEM validation;
- Address other main issues in the review comments.

-------------------- Review 1 --------------------

Overall Recommendation: 5 (5 - marginal - only just acceptable)
Evaluation Confidence: 4 (4 - Pretty confident, I know this area well)

Summary: This paper describes an elastoplastic deformation model under the peridynamics framework, and augments it with the possibility to simulate a large range of brittle and ductile fracture behaviors.

The model is the main contribution, and it definitely shows the ability to animate interesting fracture behaviors.

Clarity of Exposition: The exposition is clear. Much of the paper is about the mechanics model, but this is well described.

Technical Soundness: I believe it is.

Quality of References: The references are extensive.

Reproducibility: The algorithm and the parameters are provided. I believe it would be possible to reproduce the work.

I'm unsure about the limitations though. The paper begins by promising that the proposed framework is particularly good for handling mechanics at crack tips. But the examples do not show any complex tearing behavior with multiple nearby material filaments, etc. The glass fracture example reveals fracture 'dust' at the particle level. This is probably due to the "numerical fracture" pointed out by the paper in the introduction, which I thought it would be addressed by the technique.

Explanation of Recommendation: I find the model in this paper sound, and it appears to be a very reasonable way for animating elastoplasticity and fracture within the peridynamics framework. I believe the paper demonstrates that diverse fracture behaviors can be animated using peridynamics.

But the paper does not demonstrate that the method can produce effects that were not already possible with other computer animation techniques. The introduction seems to promise that peridynamics, thanks to seamless handling of crack tips, can produce effects not possible before, but the examples don't show this.

I am torn with this paper. While I am convinced by the model and math, I'm not convinced by the results. The method for meshing fracture surfaces does not help, although I believe this could be fixed orthogonal to the model.

I think the authors should revise their work and show compelling examples that demonstrate the benefits of the peridynamics approach.

-------------------- Review 2 --------------------

Overall Recommendation: 5 (5 - marginal - only just acceptable)
Evaluation Confidence: 3 (3 - Moderately confident, I know as much as most)

Summary: This paper extends previous work on peridynamics to more sophisticated models of elastoplastic materials, incorporating support for Poisson's ratio, plasticity, and limited anisotropy. Peridynamics, popular in engineering and computational physics for simulating fracture, consists of a densely-connected network of point masses; masses exert forces on their nearest neighbors. Fracture is implementing by breaking links between neighboring masses. The proposed method easily fits into this existing framework, replacing simple spring forces coupling neighboring masses with a more sophisticated pairwise term.

Clarity of Exposition: Overall, the paper is well written.

In several places, the argument is made that the reason peridynamics works so well for fracture is that it uses an integrated formulation, rather than a pointwise one. This point could use further explanation and discussion -- it's true that a weak formulation can admit solutions that a strong one does not, due to lack of regularity in the solution, but doesn't the problem then get shifted to the boundary conditions? Also, is there some continuum formulation of elasticity that peridynamics discretizes? This would be interesting to discuss. That "magic" of peridynamics is that it gives good results even when the family size is orders of magnitudes larger than the grain size of the material being simulated, and it's not clear to me why this is the case, mathematically.

Equation 1 needs more explanation. What does the "volume of x" mean? The volume of the Voronoi cell belonging to x? I assume x' is the variable being integrated over? But I would expect this to be a finite sum, rather than an integral, since there are only finitely many neighboring points x' in the family?

More motivation for why the different terms (equations 3-15) have the form that they do would be helpful. For example, why the two positions terms in equation 3, and not just theta? Also, where does the \delta/4 term come from in equation 8? If one were just subtracting the dilation component from total bond extension, one would get e_{ij} minus the second half of equation 3, which does not contains any \deltas.

I don't completely buy the need for the \gamma term, at the end of section 4.2. Its use implies that if I take the beams in figure 7, and kept extending them arbitrarily far, that it would reach some limit where the deformation became purely elastic again, since the plastic deformation had reached the limit. This seems the opposite of what a real material would do. The text mentions that \gamma makes the simulation "more contol[able]." More explanation, and some examples showing the difference between using and omitting this \gamma factor, are needed.

Similarly, the modification discussed at the end of section 5.1 smells a bit fishy to me. Isn't equation 17 already discretization-dependent? For example, let's say I take a flat rectangle of material, and uniformly stretch it (as in figure 7). Why would longer edges stetch more (according to equation 17) than short edges? Equation 17 is essentially measuring the Cauchy strain in each edge, which I would expect to be discretization indepedent. So I don't understand the need for the correction in equation 18. Moreover, equation 18 is not discretization *dependent*, since long edges will snap when subjected to less strain the short edges. (As a final thought experiment, consider replacing a long edge with two short edges of half the length. Using equation 17, the new pair of edges will snap at the same amount of total extension as the long edge, whereas the pair of edges will snap later if equation 18 is used.)

Comparing the method against FEM is a great idea; it's a pity only two comparisons were carried out (in figure 9).

Technical Soundness: Yes, though I didn't carefully check the constitutive models against those in the mechanics literature, and it's not obvious to me how several of the equations were derived (see above).

Quality of References: They are adequate.

Reproducibility: Yes. Although the formulas used are in some places mysterious, they are clearly described and should not be too hard to reimplement.

Explanation of Recommendation: This paper extends peridynamics to allow for more general types of elastoplastic materials, and demonstrates the power of the method by running simulations of several times of brittle and ductile fracture. The figures and supplemental video are convincing, and the paper is well-written, despite the fact that some equations could benefit from more explanation and motivation. My main hesitation with this paper is that the ideas, while new to computer graphics simulation, are standard in computational physics and engineering, where peridynamics is already a popular method for simulating fracture and where constitutive models incorporating plasticity have already been developed. That said, although the novelty of the paper is not high, it's possible that the methods described here will be of interest to practitioners in the games and movie industry, who may not be aware of the work in engineering and computational physics and for whom the simplicity and high performance of peridynamics is surely appealing.

-------------------- Review 3 --------------------

Overall Recommendation: 7 (7 - good)
Evaluation Confidence: 4 (4 - Pretty confident, I know this area well)

Summary: This paper proposes a peridynamics-based framework for simulating elastoplastic solids, brittle fracture and ductile fracture. The main contribution is forming the solution in term of elastoplasticity with consitutive models and an intergral-based formulation that doesn't require complicated treatment at crack boudnaries.

Clarity of Exposition: Overall it is OK.
Please use shorter notations for A deviatoric and A dilation.
Provide a step overview of the computations performed in each time step. Either as a latex list, or as a psudocode table. See below for more revisions I suggest that are needed for final acceptance version.

Technical Soundness: External reference such as MO14 is required to validate the technical soundness. If this paper is accepted, I would like to see a supplementary document or appendix that shows how one can derive the peridynics consitutive model from a classic hyperelastic energy density function that is formulated in terms of strain measures such as deformation gradient. According to the texts in the paper, such derivation should be doable for any model. If there is additional technical complication, at least the derivation for linear elasticity should be provided.

Quality of References: yes

Reproducibility: yes

Explanation of Recommendation: The paper is about fracture. The results are not particularly impressive compared to previous fracture methods, probably due to the shortcoming of the meashing and not-that-carefully-configured rendering. The main contribution, however, to me, is introducing to the graphics community that peridynamics can be an alternative to existing elastoplastic simlation methods. This point can be shown by demonstrating the ability for simulating a wide range of hyperelastic consitutive models. I recommend this paper be accepted The isotropic elasticity formulation refers to SEW07 and MO14 for the equivalence of peridynamics consitutive model to classical hyperelastic models. It is a little frustrating to see this paper eventually chose linear elasticity instead of one that supports large deformation (while some of the examples, especially the ductile ones, could clearly be largely imporved with a model such as corotated or neo hookean). The author should provide a discussion on the choice motivation, and what technical difficulty will arrive if someone wants to implement the framwork with different constitutive models.

In a lot of the elastic examples the motion is significantly damped (which one would usually see in an implicit time integration scheme like backward Euler.) Is this problem studied? A discussion would be helpful.

How is the time integration of the governing equation discretized. Please provide something like Section 4 in LBC14 and explain how the integral over Hx is computed.

There are other shortcomings such as tet boundary aligned embedded mesh (discussed in the paper).. Mesh postprocessing will help. This is just a minor aspect of the paper though.

I also hope to see a discussion on element inversion. Does peridynamics naturally handle that? If so, please include such an example (e.g., randomly initially displaced cube), it will greatly improve the results. If not please explain why.

-------------------- Review 4 --------------------

Overall Recommendation: 6 (6 - acceptable)
Evaluation Confidence: 4 (4 - Pretty confident, I know this area well)

Summary: This framework extends the Peridynamics framework, which was first introduced to graphics by Levine et al., to handle elastoplasticity, ductile fracture and brittle fracture. The proposed formalism is meshless and easy to implement due to its integral-based, as opposed to differential-based, nature. The model is validated by showing comparisons to FEM and varying material parameters. The framework is proposed to be an alternative to existing methods for modelling elastoplasticity.

Clarity of Exposition: The exposition is quite clear. It can be improved by showing examples/comparisons that show the advantage of Peridynamics over existing methods.

Technical Soundness: Yes.

Quality of References: Yes.

Reproducibility: Yes.

Explanation of Recommendation: The authors have extended the Peridynamics framework to handle a wide range of phenomena, in an attempt to make it an attractive alternative to existing methods. The paper has a good deal of technical contribution and the authors have shown a variety of examples to support their claim. The paper is well organized and the exposition is clear. The paper adds a good deal of contribution over Levine et al.

As mentioned above, one of my biggest criticism is that the authors have not shown the advantage of using Peridynamics over existing methods. Although it is academically/mathematically interesting to have yet another method for modelling visual effects, the new method will only be adopted if it has some advantage over the existing methods - especially now that graphics is quite mature and most groups already have some existing code base. Hence I feel that some comparison examples that demonstrate that the proposed framework is better (faster, more accurate, more art-directable, etc.) can significantly improve the impact of the paper.

I feel that the FEM comparison shown in Figure 9 is not strong enough. The example is too simple and almost '1 dimensional' in some sense. Hence it feels like most methods with some control over the parameters should be able to match the FEM sims in this example. It would be great to see comparisons with FEM for a more complex example, possibly involving some fracture or plasticity. It would also be interesting to know if the FEM sims use the same material parameters as the Peridynamics sims for achieving the same effect.

The example shown in figure 6, was previously simulated by HJST13. A visual comparison between the two seems to suggest that the result in Figure 6 has much lower visual fidelity. There are quite a few interesting effects that can be seen in Figure 1 of HJST13 that are missing in Figure 6 of this paper - 1) As the bullet moves through the jello that size of the cavity varies. It is largest near the bullet and tapers off behind it. 2) Jello seems to expand vertically above and below the bullet. 3) The oscillation of the jello is visually consistent with the motion of the bullet and looks very visually pleasing. Whereas in the example shown in figure 6, the oscillation of the jello almost seems to have no correlation with the bullet. I am not sure if this is some drawback of Peridynamics or just a bug in the implementation or just different parameters. It would be interesting to see if the authors can match the result from HJST13.

Similar to figure 2 in Levine et al., the glass wall fracture shown in figure 1 of this paper has a very jagged/powdery (as opposed to crisp) feel to it. Maybe it is related to issue shown in Figure 11 where we see jagged surfaces. Generating geometry for rendering was one of the limitations of Levine et al., and I feel like it should have been addressed by this paper since it is trying to make Peridynamics a mainstream simulation method. Could the authors comment of why they chose not to smooth these surfaces or alternatively use a finer mesh?

To summarize, I feel that the paper has a lot of potential and can be a high impact paper if some of the concerns mentioned above are addressed.