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Oddy Spikes in bubbleShockNew

Created by Brian J. Gallagher, last modified on 2016-10-26

I've learned some interesting things about the oddy spikes we observed in the bubbleShockNew simulation data:

1. The spikes do not occur at just a single cycle (Figure 1a). They are quite steep, but ramp up and down smoothly (often over hundreds of cycles). So, it will be difficult to eliminate the spikes using a median filter.

2. Every failure has a spike, but there is a lot of variance in the height of the spikes and the time-to-failure at which the spikes occur (Figure 1c). So, oddy on it's own probably won't reliably predict time to failure.

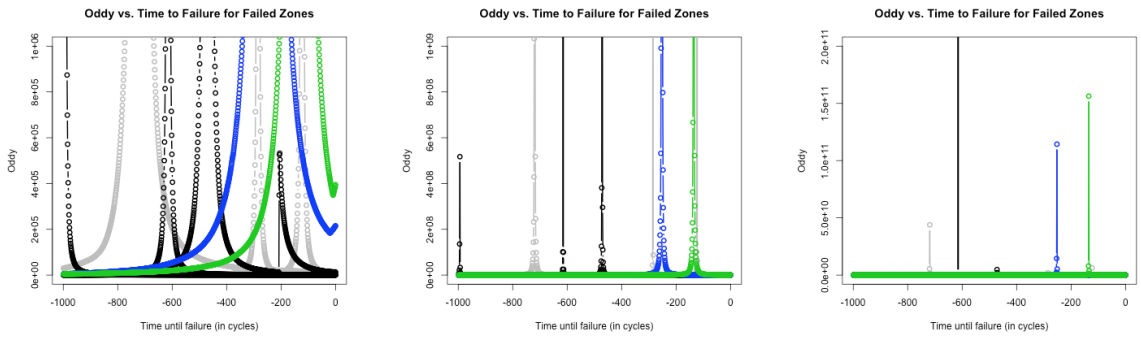


Figure 1: Oddy values for a sample of 8 failed zones for the 1000 timesteps preceding failure. Each line represents an individual failed zone. The only difference between (a), (b), and (c) is the y-axis scale. At smaller scales, the smoothness of the ramp up and down is apparent. At larger scales, the variance in height of the spikes is apparent. Zone 10784 appears in blue, zone 10807 appears in green.

3. Non-failed zones also exhibit oddy spikes, but they are much smaller (10^2 - 10^3) (Figure 2a). The fact that the spikes always occurs within 1000 cycles of failure and that non-failed zones do not exhibit large spikes indicates that these spikes may provide a reliable early indicator of failure, at least for the bubble shock simulation.

4. The spikes do not appear to affect any of our experimental results to date. There is no evidence of spikes in the actual data we train/evaluate on, with the exception of the very tail end of the spikes for zones 10784 and 10807 (Figure 2). This is expected since our history window is < 100 and all of the spikes peak outside this range.

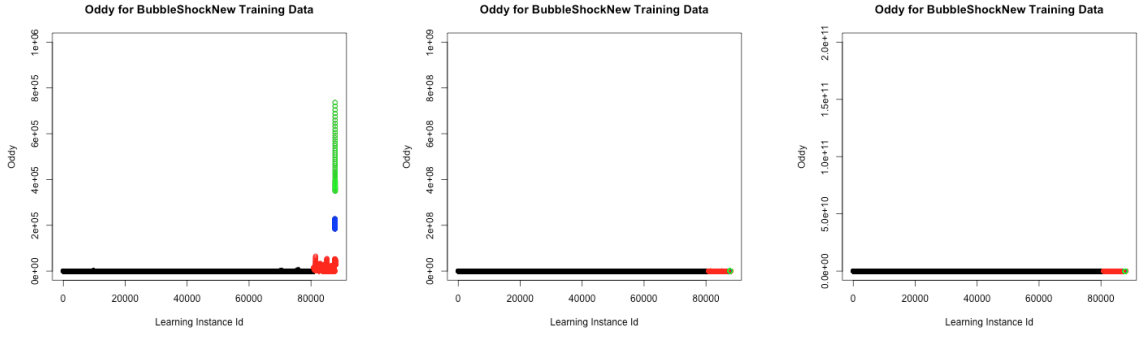
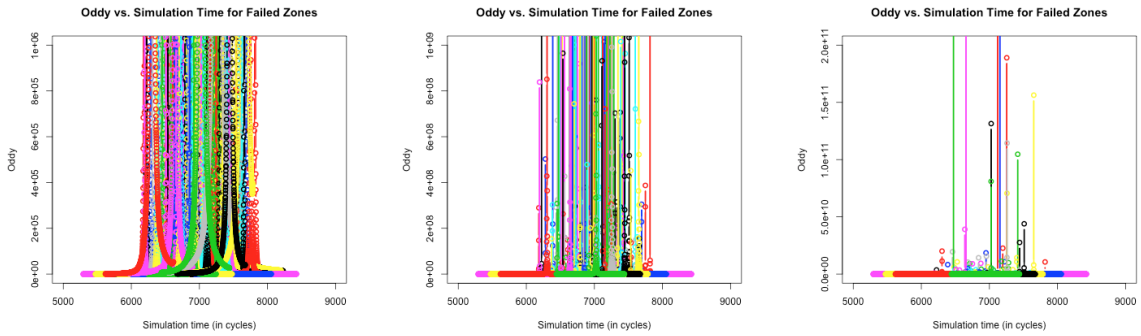


Figure 2: Oddy values for each learning instance in the bubbleShockNew data. Non-failures (black) are drawn every 1000 cycles starting at cycle 0. There are 140 failed zones (colored), each of which has a history window size of 50. The blue points represent the 50 history cycles for zone 10784. The green points represent the 50 history cycles for zone 10807. The relatively high oddy values for these zones are actually the very tail end of the spike for these failures (see blue and green lines in Figure 1). The remaining 138

failures appear in red. Again, the only difference between (a), (b), and (c) is the y-axis scale.

5. The spikes all occur within a fairly narrow region of the simulation (Figure 3). My guess is that these spikes in oddy are the result of a physical event in the simulation (perhaps the shock wave contacting the bubble), but this remains to be investigated.



(a) **(b)** **(c)**

Figure 3: Oddy values for each of the 140 failed zones for the 1000 timesteps preceding failure. Each line represents an individual failed zone. Again, the only difference between (a), (b), and (c) is the y-axis scale.

Next Steps:

1. Try history window of 1000 instead of 50 or 100 and see if this improves the predictor and/or increases the feature importance of oddy.
2. Check-in with Josh to see whether the oddy spikes make sense based on the physics of the bubble shock problem.

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5 Comments

Ming Jiang

Wow, that's really interesting!

Joshua B. Kallman

This is all data taken without any relaxation happening, correct? Do these zones fail due to negative side volumes? I can do a run of my own of one of them and look at the detailed VisIt output for comparison.

Ming Jiang

Josh, this data came from the "failure generation" procedure, which does not include any general relaxation parameters. The only relaxation that occurs is on the failed zones from previous runs.

Brian, do you know if the oddy spikes occur for all failures, including the first run? I want to make sure that this is not an artifact of our failed zones relaxation.

Brian J. Gallagher AUTHOR

Yes, every failure has an oddy spike, including the first one. The first failure I see is zone 1062 at cycle 6293. This zone has an oddy spike that peaks at cycle 6194 (99 cycles before failure) with an oddy of 8e8.

Joshua B. Kallman

I guess I'm wondering what causes the zone to fail in general. What are the other verdict metrics the cycle before failure? Oddy seems pretty low in most cases. I am trying to eliminate a correlation with something else.