Answers to leftover chat room questions from *Vikram Shyam's* Seedling Seminar presentation *Real-Time Closed-Loop Modulated Turbine Cooling,* February 27, 2014

Joel Wagner:
Glad to see detailed thermal measurement system development. Modulated cooling control is a great opportunity to increase cycle performance. Would cooling flow diversion through the combustor also require the controller to also control the fuel flow to maintain desired turbine inlet temperatures? Also glad to see film cooling work at NASA.

Vikram Shyam:
This is a good point. Joel is correct if the cooling flow is being diverted completely back to the combustor, it would be a good idea to control and monitor fuel flow to account for the changing core flow so that thrust is not altered. We started out by considering that it might be possible to have a hierarchy of modulation so that modulation could occur at the compressor, turbine blade row, and turbine blade level. Each would require the engine to react in a different way and we did not explore all the possibilities in phase 1.

Joel Wagner:
Would this film cooling modulation be applicable for turbines with CMC airfoils?

Vikram Shyam:
Yes, CMCs would require tighter requirements on gradients (versus absolute temperature levels). But we have heard that CMCs will actually drive designs MORE toward film-cooling and less toward internal-cooling schemes for this very reason.

Joel Wagner:
Lastly, how fast is the imaging recording of the phosphor thermometry?

Vikram Shyam:

The better temperature maps that were shown using phosphor thermometry would correspond to image recording of about 1 frame/minute (1 temperature map was extracted from 20 exposures). However, as Jeff mentioned at the talk, we could collect as fast as about 1 temp map/sec, but with sacrifice in accuracy/resolution.