Note on K2 after GMS Upgraded to 2.2.0.1518 on Jan 18, 2013

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On K2 computer, Gatan software GMS has been upgraded to version 2.2.0.1518.0 since afternoon of Jan. 18, 2013. I am writing this up for anyone who is interested in the new version together with K2 performance.

You can also get pdf version of this document here (article.pdf).

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1 A few changes according to Gatan

There are a few changes as they told me over the phone while upgrading was going on. I am not sure if the information I list below is 100% accurate.

- Now shutter control is through hardware directly. With old version, it was via software. The new change is meant to make K2 timing more accurately.
- New version crops camera size by 2 pixels at each dimension.
- For gain reference preparation, there are now only for Linear and Super-res modes. The step for Counted mode is no longer there. The hardware gain correction for Counted mode is derived from that of Super-res mode.
- For preparing gain reference, we don’t need to bother orientation of the camera output. New software takes care of that.
- Now the minimum exposure time for single shot is 0.1 second and for dose fractionation frames is 0.025 second. They are shorter than that with the older version.
2 Power Spectrum of Images from all Three Modes

After freshly preparing gain reference images for the specific 300kV, I collected images from all three modes. For counted and Super-res modes, the dose rate on physical chip is about 10 electron/pixel/second. And for Linear mode, it is about 600 electron/pixel/second.

Above is the Power Spectrum from a Linear mode image at dose rate of 600e/pixel/second. The lines can still be seen.
The above is one from Counted Mode. There is a small, but sharp line in the middle. Other than that, the background is flat.
The above is the one from Super-res image. It is almost perfect. This is significantly better than from the old version.

3 Data Storage Location

For normal single shot images, there are a few options.

On Fileserver.

- /data500, a 500GB SATA drive exported to Tecnai F20, Tecnai F30 and K2 computer via Samba/CIFS protocol. This disk is also exported to Leginon - 192.168.1.4 via NFS share.
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- A 12TB disk array in RAID5 configuration (~9TB usable) is attached to fileserver too. It is an USB 2.0 interface and a hardware RAID enclosure. And the filesystem I chose to have on for it is ZFS (http://en.wikipedia.org/wiki/ZFS). I have been testing the reliability of the filesystem on this large array. So far, so good. This big disk storage /datatank is also available for both Tecnai F20 and Tecnai F30 to mount as network drive.

K2 movie data, speed is a big concern.

For dose-fractionation (movie) series data collection, there are even more options. Beside the above two disk devices being available to be mounted on K2 Win7 computer, there are three disks locally on K2 computer, D:\Data, X:\ and Y:\. However, currently, dose-fractionation data collection from SerialEM requires faster disks than USB2.0. Small series might OK, large series will cause "timeout" error for SerialEM. The final summed image frame from the stack returning to SerialEM seems a lot slower than with a SATA controller. Except the timeout error, the movie stack is written directly to the disk drive from K2 computer, which doesn’t cause any problem though. In other word, even if you don’t care about not being fast, the timeout error related to slow disk drive will pulse and pop up an error message window on SerialEM. Obviously, this will interrupt the automation of data collection.

Therefore, if you collect multiple movie stack files using SerialEM, you are better off using /data500 network drive or one of the local disks on K2. Preferably, D:\Data should be used, as X:\ and Y:\ are used for K2 temporary intermediate files. And if they are full, K2 camera will not behave.

4 Current Issues or Problems

- [Update 4 - Jan 24, 2013] Fixed! Part of the problem is caused by filename of the gain reference files. If the gain reference files are collected with "link" to kV, then there is [200] or [300] will be part of the filename. Somehow, DM consults it still even we have new one without the[]. Now SerialEM should run with no crashing at all and fully automatically for movies too.

  [Update 3 - Jan 22, 2013] Tom of Gatan sent another patch, even he could not reproduce the same error message on his system. It appears scripting problem is only related to Counted and Super-res mode. Will install this patch and report again.

  [Update 2 - Jan 22, 2013] Installed the patch that Tom sent me last night. Taking binned image from DM interface works now. However, it still doesn’t work if run a Gatan script to take the same image, at least this is what I saw for Counted image. It is certain that the bug is in gain normalization step, as it we define "unprocessed" or "dark subtracted", it works fine with scripting then. Sent report to Gatan and wait for their reply.

  [Update 1 - AM Jan 19, 2013] Gatan found the source of the bug and sent me a patch to be installed.

There is a bug in gain normalization step. DM can not take binned image, unless the orientation and flip in camera configuration are both set to 0. This might not sound terrible, but it is very bad for SerialEM because all SerialEM calibration for K2 and all other cameras are done with camera orientation configured to make image displayed on DM the same as on large fluorescent screen of microscope. Moreover, with non-consistant camera orientation, it is risky to run into handness trouble. Gatan acknowledged the issue and is trying to see if they can provide us a patch to fix this. I am a little surprised that this obvious feature has not been spotted and tested out in past months.

- [Update - Jan 24, 2013] After a lot of tests, I believe the hanging problem as with previous version of DM is now gone.

I am testing it at the moment, but I haven’t reproduced that random hanging issue of DM we had with the previous version. With the old version, if we take a lot of image, DM will certainly hang eventually. We had to kill DM and
restart it again. I am crossing my fingers right now that this has been fixed for good.