Re: [External]RE: CSM Multi-Point Enhancement Design Review

Rose, Eugene <Eugene.Rose@centauricorp.com>
Wed 12/29/2021 1:59 PM

To: Settergren, Reuben J (US) <reuben.settergren@baesystems.com>; Steven.W.Ramberg@nga.mil <Steven.W.Ramberg@nga.mil>; Jonathan.W.Regan@nga.mil <Jonathan.W.Regan@nga.mil>; YunTing.Su@nga.mil <YunTing.Su@nga.mil>; Damien.A.Kerr.ctr@nga.mil <Damien.A.Kerr.ctr@nga.mil>; Rodarmel, Craig <Craig.Rodarmel@centauricorp.com>; antaninia.lallement.ctr@nga.mil <antaninia.lallement.ctr@nga.mil>; roberto.p.canavosiozuzelski.ctr@nga.mil <roberto.p.canavosiozuzelski.ctr@nga.mil>; Theiss, Hank <Hank.Theiss@centauricorp.com>; Christopher.c.clasen@nga.mil <Christopher.c.clasen@nga.mil>; Joseph.M.Grocholski@nga.mil <Joseph.M.Grocholski@nga.mil>; Joseph.M.Swed.ctr@nga.mil <Joseph.M.Swed.ctr@nga.mil>; Wayne.E.Ludwig@nga.mil <Wayne.E.Ludwig@nga.mil>; neil.c.sunderland.ctr@nga.mil <neil.c.sunderland.ctr@nga.mil>; david.a.mize@nga.mil <david.a.mize@nga.mil>; john.a.freels@nga.mil <john.a.freels@nga.mil>; david.a.bonner@nga.mil <david.a.bonner@nga.mil>; kateri.w.garcia@nga.mil <kateri.w.garcia@nga.mil>; Lisa.M.Laforest@nga.mil <lisa.m.laforest@nga.mil>; Marshall, John <John.Marshall@centauricorp.com>

Cc: Tolman, Cam <Cam.Tolman@centauricorp.com>

Reuben, please see my responses in RED.
Gene

From: Settergren, Reuben J (US) <reuben.settergren@baesystems.com>
Sent: Wednesday, December 22, 2021 9:27 PM
To: Rose, Eugene <Eugene.Rose@centauricorp.com>; Steven.W.Ramberg@nga.mil <Steven.W.Ramberg@nga.mil>; Jonathan.W.Regan@nga.mil <Jonathan.W.Regan@nga.mil>; YunTing.Su@nga.mil <YunTing.Su@nga.mil>; Damien.A.Kerr.ctr@nga.mil <Damien.A.Kerr.ctr@nga.mil>; Rodarmel, Craig <Craig.Rodarmel@centauricorp.com>; antaninia.lallement.ctr@nga.mil <antaninia.lallement.ctr@nga.mil>; roberto.p.canavosiozuzelski.ctr@nga.mil <roberto.p.canavosiozuzelski.ctr@nga.mil>; Theiss, Hank <Hank.Theiss@centauricorp.com>; Christopher.c.clasen@nga.mil <Christopher.c.clasen@nga.mil>; Joseph.M.Grocholski@nga.mil <Joseph.M.Grocholski@nga.mil>; Joseph.M.Swed.ctr@nga.mil <Joseph.M.Swed.ctr@nga.mil>; Wayne.E.Ludwig@nga.mil <Wayne.E.Ludwig@nga.mil>; neil.c.sunderland.ctr@nga.mil <neil.c.sunderland.ctr@nga.mil>; david.a.mize@nga.mil <david.a.mize@nga.mil>; john.a.freels@nga.mil <john.a.freels@nga.mil>; david.a.bonner@nga.mil <david.a.bonner@nga.mil>; kateri.w.garcia@nga.mil <kateri.w.garcia@nga.mil>; Lisa.M.Laforest@nga.mil <lisa.m.laforest@nga.mil>; Marshall, John <John.Marshall@centauricorp.com>; Jacqueline.S.Carr.ctr@nga.mil <Jacqueline.S.Carr.ctr@nga.mil>; Michael.W.Nolte@nga.mil <Michael.W.Nolte@nga.mil>; Krinsky, Irwin S (US) <irwin.krinsky@baesystems.com>; John.Karp@L3Harris.com <John.Karp@L3Harris.com>; Scott.Minster@L3Harris.com <Scott.Minster@L3Harris.com>; Kunkel, Gregg W (US) <gregg.kunkel@baesystems.com>; Lam, Kevin N (US) <kevin.lam@baesystems.com>; christopher.b.prombo.ctr@nga.mil <christopher.b.prombo.ctr@nga.mil>; Megan.M.Ritelli@nga.mil <Megan.M.Ritelli@nga.mil>; Dodd, Alan <Alan.Dodd@centauricorp.com>; Gaska, Peter <Peter.Gaska@centauricorp.com>; Lee, Mark <Mark.Lee@centauricorp.com>; Braun, Aaron <Aaron.Braun@centauricorp.com>; terence.a.wynn@nga.mil <terence.a.wynn@nga.mil>; Voisin, Sophie <voisins@ornl.gov>; Davis, Christopher <daviscr@ornl.gov>; ahardin@sandia.gov <ahardin@sandia.gov>; dwhite@sandia.gov <dwhite@sandia.gov>; thomasoh@ornl.gov <thomasoh@ornl.gov>
Cc: Davis, Christopher <daviscr@ornl.gov>; Voisin, Sophie <voisins@ornl.gov>; Joseph.M.Grocholski@nga.mil <Joseph.M.Grocholski@nga.mil>;

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Subject: [External]RE: CSM Multi-Point Enhancement Design Review

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To the CSMWG

BLUF: a CSM stakeholder with requirements for a GPU-optimized CSM sensor model should try out any proposed multipoint interface and verify that it meets their requirements, or the CSMWG risks all the work of adding elements to the CSM interface that in the end won't get used.

Yes, I agree.

--details--

Since yesterday's multipoint review, I shared the proposals with Shannon McDonald, who has a lot more experience than me with writing GPU code. (I apologize for not doing this earlier, so that his feedback could be included)

We are pessimistic whether the multipoint interface in its approximately final form would sufficiently support a meaningfully efficient GPU implementation of a sensor model.

Typically the long pole in a massively parallel GPU computation is transferring the inputs from RAM into GPU memory, and then transferring the outputs back to RAM. A lot of potential speedup would be left on the table if there were no accounting for leaving outputs on the GPU for subsequent calculations, or using previous calculations in GPU memory as inputs.

Yes, data transfer between CPU and GPU is typically the bottleneck. GPU vendors have tried to address this in various ways, but It is largely still true I believe.

Consider a use case of a mass imageToTerrain calculation, where you have to alternate between i2g at terrain heights, and interpolating new heights from the terrain source. Each multipoint call to i2g would input a std:: container, copy it to GPU, do the i2gs, copy it back to CPU. Likely the implementer would want to put the terrain interpolation onto the GPU as well, so back and forth again.

This is an example of algorithm optimization, not technically sensor model optimization.

Other examples of this include stereo intersection
The "imageToTerrain" calculation, or "imageToGround with a DEM" is typically an iterative process that uses both i2g and g2i. It might also use ground partials within the iteration loop to compute corrections.

In the single point case, this is currently done by the SET using the existing API calls and by calls to retrieve elevations from the DEM. You are correct, there is not a proposed multi-point method that would do this process within a single call. However, that could be added to the interface at this point if it's what the community wants. Something like:

<vector of ground points> = iterativeMultiPointImageToGround(
                            <vector of image points>,
                            reference to DEM, ... <other details like interplation method etc...>)

I suggest that we take a step back and speak with Shannon and others who have GPU use cases in mind to see if we can collect a set of such algorithms that are of most interest. CSM might not be the best place to implement those algorithms, however.

I realize this is not a perfect example, as it would be better to multipoint compute loci per image point, and use those for the terrain intersection, but I think the point stands: a i2g or g2i or partials or whatever (whether single- or multi-) is generally not done for its own sake, but as one link in a processing chain.

Agree.

Shannon also advises that interface upgrades to support GPU optimized sensor models should include runtime control over selection/configuration of GPU devices (because big boy hardware has many GPUs, which might be partially reserved for other processing, etc). An interface intended to support GPU might have to make an early decision to cater to NVIDIA/CUDA, or other try generalize to other GPU standards (OpenCL?)

Agree. This is a proposal that I made in our initial TEM. A way to "govern" the sensor model and prevent developers from building code that takes down the entire grid.

If the current proposal turns out to support only limited GPU benefit, implementors may well choose to sidestep CSM and code a bespoke GPU-centric capability. A multithreaded implementation inside the wrapper is not likely to have significant benefits vs simply multithreading calls to the existing RasterGM interface.

I agree, implementers such as Sandia might choose to sidestep CSM if the interface does not buy them anything I agree that the multithreaded implementation could be done with no modifications to the existing API and it would be just as efficient.

At this time BAE does not have the bandwidth, or specific requirement to GPU-optimize a sensor model. So as far as I know, that leaves the National Lab (no longer Oak Ridge but now Sandia?) as the most likely (only?) current target for this enhancement. It would be great if they could take an action to test a GPU optimization of a simple model (RPC? pinhole?) behind this proposed interface, and provide concrete feedback whether they would use the multipoint interface in its current form, or what further changes would be necessary.

Using the proposed interface, I don't think the feedback will be positive based on what you've said.
The proper approach from here, I believe is:
. Identify actual GPU use cases.
. Determine if the use cases merits the work required to implement multi-point/bulk-point calls.
. Determine if the CSM library is the right place to implement these algorithms.
. Design a set of GPU-friendly API methods that do support the use case.
. Rather than rely on the labs to work with us out of the kindness of their hearts, create contractual relationships to do the prototyping.

AND... Continue discussing the design alternatives presented at the last design review.

Thanks for your considerations, sorry this is so close to the holiday!

r

From: Rose, Eugene <Eugene.Rose@centauricorp.com>
Sent: Monday, December 20, 2021 12:48 PM
To: Rose, Eugene <Eugene.Rose@centauricorp.com>; Steven.W.Ramberg@nga.mil; Jonathan.W.Regan@nga.mil; YunTing.Su@nga.mil; Damien.A.Kerr.ctr@nga.mil; Rodarmel, Craig <Craig.Rodarmel@centauricorp.com>; antaninia.lallement.ctr@nga.mil; roberto.p.canavosiozuzelski.ctr@nga.mil; Theiss, Hank <Hank.Theiss@centauricorp.com>; Christopher.c.clasen@nga.mil; Joseph.M.Grocholski@nga.mil; Joseph.M.Swed.ctr@nga.mil; Wayne.E.Ludwig@nga.mil; neil.c.sunderland.ctr@nga.mil; david.a.mize@nga.mil; john.a.freels@nga.mil; david.a.bonner@nga.mil; kateri.w.garcia@nga.mil; Lisa.M.Laforest@nga.mil; Marshall, John <John.Marshall@centauricorp.com>; Jacqueline.S.Carr.ctr@nga.mil; Michael.W.Nolte@nga.mil; Krinsky, Irwin S (US) <irwin.krinsky@baesystems.com>; John.Karp@L3Harris.com; Scott.Minster@L3Harris.com; Kunkel, Gregg W (US) <gregg.kunkel@baesystems.com>; Lam, Kevin N (US) <kevin.lam@baesystems.com>; christopher.b.prombo.ctr@nga.mil; Megan.M.Ritelli@nga.mil; Dodd, Alan <Alan.Dodd@centauricorp.com>; Gaska, Peter <Peter.Gaska@centauricorp.com>; Lee, Mark <Mark.Lee@centauricorp.com>; Settergren, Reuben J (US) <reuben.settergren@baesystems.com>; Braun, Aaron <Aaron.Braun@centauricorp.com>; terence.a.wynn@nga.mil; Voisin, Sophie <voisins@ornl.gov>; Davis, Christopher <daviscr@ornl.gov>; ahardin@sandia.gov; dwhite@sandia.gov; thomasoh@ornl.gov
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Tolman, Cam <Cam.Tolman@centauricorp.com>; Dodd, Alan <Alan.Dodd@centauricorp.com>
Subject: Re: CSM Multi-Point Enhancement Design Review

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</table>

Here are the charts that will be presented at tomorrow's CSM Multi-Point Enhancement API Design Review. (12PM EST).
Thank you.
Gene

From: Rose, Eugene
Sent: Thursday, December 2, 2021 3:44 PM
To: GAS_EXTERNAL
Cc: Davis, Christopher <daviscr@ornl.gov>; Voisin, Sophie <voisins@ornl.gov>; Joseph.M.Grocholski@nga.mil <Joseph.M.Grocholski@nga.mil>; Jacqueline.S.Carr.ctr@nga.mil <Jacqueline.S.Carr.ctr@nga.mil>; Scott.Minster@L3Harris.com <Scott.Minster@L3Harris.com>; Theiss, Hank <Hank.Theiss@centauricorp.com>; Steven.W.Ramberg@nga.mil <Steven.W.Ramberg@nga.mil>; Megan.M.Ritelli@nga.mil <Megan.M.Ritelli@nga.mil>; Joseph.M.Swed.ctr@nga.mil <Joseph.M.Swed.ctr@nga.mil>; Michael.W.Nolte@nga.mil <Michael.W.Nolte@nga.mil>; Gaska, Peter <Peter.Gaska@centauricorp.com>; Lee, Mark <Mark.Lee@centauricorp.com>; Tolman, Cam <Cam.Tolman@centauricorp.com>; Dodd, Alan <Alan.Dodd@centauricorp.com>
Subject: CSM Multi-Point Enhancement Design Review
When: Tuesday, December 21, 2021 12:00 PM-2:00 PM.
Where:

Time changes to accommodate some participants.
A technical review of a proposed solution for a CSM enhancement requirement. Slides and code are attached. Please use the attached comment review matrix. **Please send comments by DECEMBER 13 2020**. You can comment on any of the documents. Please forward to others who might be interested.

Meeting link: https://nga.webex.com/meet/steven.w.ramberg

    Meeting number: 199 012 8780

    Video address: steven.w.ramberg@nga.webex.com

    Audio connection: +1-415-527-5035
    Phone Access code: 199 012 8780 # (919095 #)