



Evon Silvia <esilvia@quantumspatial.com>

US - Las Working Group - Edge of Flightline flag

24 messages

Christian Sevcik <csevcik@riegl.com>

Mon, Mar 14, 2016 at 7:29 AM

To: Lewis Graham <lgraham@geocue.com>

Cc: Michael Rosen <mrosen@lizardtech.com>, "sdharmapuri@mbakercorp.com" <sdharmapuri@mbakercorp.com>, Wanning Peng <wpeng@esri.com>, Arttu Soinen <arttu.soininen@kolumbus.fi>, Christopher Parrish <Christopher.Parrish@oregonstate.edu>, David Reid <david.reid@optech.com>, Derek Morris <dmorris@geocue.com>, Gerhard Loeffler <Gerhard_Loeffler@trimble.com>, Howard Butler <hobu.inc@gmail.com>, Evon Silvia <esilvia@quantumspatial.com>, "Martin Isenburg (martin.isenburg@gmail.com)" <martin.isenburg@gmail.com>, H Karl Heidemann <kheidemann@usgs.gov>, Mike Umansky <mumansky@appliedimagery.com>, Paul Galla <paul.galla@leicaus.com>, Ramesh Sridharan <ramesh.sridharan@virtualgeomatics.com>

Hello LWG,

We received a request to populate the edge of flight line flag.

According to the standard - I refer to las specification version 1.4 r13, July 2013- the flag is defined as:

For point data records 0-5

"Edge of Flight Line: The Edge of Flight Line data bit has a value of 1 only when the point is at the end of a scan. It is the last point on a given scan line before it changes direction."

For point data records 6-10

"Edge of Flight Line: The Edge of Flight Line data bit has a value of 1 only when the point is at the end of a scan. It is the last point on a given scan line before it changes direction or the mirror facet changes. Note that this field has no meaning for 360° Field of View scanners (such as Mobile LIDAR scanners) and should not be set."

This brings up 3 questions and I wonder, if there is consent within the group ;-)

Definition 1 can only apply to oscillating mirror scanners, as there is no change in direction for a rotating polygon wheel mirror scanners.

This also means that there is no edge of flightline flag in LAS files version 1.1 -1.3 for polygon wheel scanners.

Definition 2 explicitly addresses facet change and therefore allows to set this flag for polygon wheel scanners for LAS 1.4 and point data record format 6 -10.

As it is stated, only the last point before a facet change can be flagged as edge of flight line, 'edge points' are created on one side of the flight line only. As I understand the intention of the flag is to quickly calculate for the ground coverage of a flightline, but we seem to get stuck here.

Question 2 is about circular scan patterns. There is neither a change in direction, nor a change of facet. For computational reasons we split a circle into a forward arc and a backward arc. Would it be safe to introduce such artificial edges?

The third question is about the returns to be flagged. Although it is not written in the standard, we assume all returns of a 'edge of flightline' pulse get the flag.

Can anyone agree on that?

I would appreciate your comment on this.

Thanks
ChristianDI Christian Sevcik
Manager| Strategic Software AlliancesRIEGL Laser Measurement Systems GmbH
Riedenburgstrasse 48, 3580 Horn, Austria

Phone: +43-2982-4211
Fax: +43-2982-4210
e-mail: csevcik@riegl.com
www: <http://www.riegl.com>

Heidemann, Hans <kheidemann@usgs.gov>

Mon, Mar 14, 2016 at 8:54 AM

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This is only my opinion and may not represent even a plurality of the committee.

Question 1: It seems to me that, if you can flag the last point of a rotating polygon scanline, it should not be overly difficult to flag the next point, which would be the first point of the next scanline ? Perhaps not; I don't claim to know the internal intricacies of your system processing.

Question 2: I would think that the split between forward and reverse arcs would/should provide a very close approximation of the edges of the swath. Obviously, variations in flight attitude will prevent this from being an absolutely exact boundary, but the same limitation exists for all systems.

Question 3: I would suggest flagging the First Return. Yes, on the outbound scan, there may likely be additional points beyond the First, but the opposite will happen on the inbound scan as well, so it's a pick your poison kind of question. The difference is not likely to be significant either way, flagging the First seems like it would be simpler. Flagging all returns of the pulse is likely to cause further complexity in downstream processing for MOST processes; the additional effort should be placed on the fewer activities that would benefit from that scheme.

Karl



H. Karl Heidemann, GISP, CMS

Physical Scientist, Lidar Science

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[Quoted text hidden]

Evon Silvia <esilvia@quantumspatial.com>

Mon, Mar 14, 2016 at 9:01 AM

To: "Heidemann, Hans" <kheidemann@usgs.gov>

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The point of the edge flag is to give users the ability to conveniently "clip" the edges of a flightline for whatever reason they deem worthy. Two examples off the top of my head include geometric distortion at flightline edges and clipping/flagging/filtering overlap areas for setting the Overlap bit. This procedure is significantly simplified by the addition of a Edge Flag.

Great question! Definitely a point that can be clarified in the spec. I don't believe there was any intent to change the definition of the Edge Flag between the point formats.

Evon

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Evon Silvia PLS
 Geomatics Specialist
 517 SW 2nd Street, Suite 400, Corvallis, OR 97333
 P: (541) 452-8502
 E: esilvia@quantumspatial.com

[Quoted text hidden]

Mail Delivery Subsystem <mailer-daemon@googlemail.com>

Mon, Mar 14, 2016 at 9:02 AM

To: esilvia@quantumspatial.com

Delivery to the following recipient failed permanently:

ramesh.sridharan@virtualgeomatics.com

Technical details of permanent failure:

Google tried to deliver your message, but it was rejected by the server for the recipient domain virtualgeomatics.com by mxmail.register.com. [209.17.115.10].

The error that the other server returned was:

550 5.7.1 <ramesh.sridharan@virtualgeomatics.com>... Relaying denied

----- Original message -----

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d=quantumspatial.com; s=google;

h=mime-version:in-reply-to:references:date:message-id:subject:from:to

:cc;

bh=XU9/OcXZFJY1FgfjwkkF3s4UfSXA6zzYqlqI0blcl8M=;

b=hyTBXDrh9swq63YseaiN08ZpgsQ9eV/2UX3+7KDCuAPxAwbSCX/V2mpl/oEsaVoV6o

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X-Received: by 10.107.11.10 with SMTP id v10mr24084816ioi.188.1457971307631;
Mon, 14 Mar 2016 09:01:47 -0700 (PDT)
Received: by 10.36.78.2 with HTTP; Mon, 14 Mar 2016 09:01:47 -0700 (PDT)
In-Reply-To: <CAEQ4rOx5fT7_YCRDqGf2_dH-e2ajG=6ivirDX3cwZbAKse470w@mail.gmail.com>
References: <2E5C300455F1D648B347262287D15E3001E1B94C@exchange.horn.riegl-gmbh>
<CAEQ4rOx5fT7_YCRDqGf2_dH-e2ajG=6ivirDX3cwZbAKse470w@mail.gmail.com>
Date: Mon, 14 Mar 2016 09:01:47 -0700
Message-ID: <CAM45a8RnWfwNY3D+36JPt=4ve1pWCSB56u6PNAdkDsEtWY2w+Q@mail.gmail.com>
Subject: Re: US - Las Working Group - Edge of Flightline flag
From: Evon Silvia <esilvia@quantumspatial.com>
To: "Heidemann, Hans" <kheidemann@usgs.gov>
Cc: Christian Sevcik <csevcik@riegl.com>, Lewis Graham <lgraham@geocue.com>,
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Content-Type: multipart/alternative; boundary=001a113f9232e263d9052e0465c5

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Great question! Definitely a point that can be clarified in the spec. I don't believe there was any intent to change the definition of the Edge Flag between the point formats.

Evon

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[image: Quantum Geospatial Logo]

Evon Silvia PLS

Geomatics Specialist

517 SW 2nd Street, Suite 400, Corvallis, OR 97333

P. (541) 452-8502

E. esilvia@quantumspatial.com

On Mon, Mar 14, 2016 at 8:54 AM, Heidemann, Hans <kheidemann@usgs.gov>

wrote:

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- > This is only my opinion and may not represent even a plurality of the
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----- Message truncated -----

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Mon, Mar 14, 2016 at 9:14 AM

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I would disagree on the point of the edge flag. In my mind, the point is, as Christian initially asserted, to more easily identify a precise edge of the swath data. My biggest concern is, perhaps, a semantic one: Evon stated that it allows a simpler means to "clip" the edges. The term "clip" is too often understood to mean "remove" -- this approach is wholly unacceptable. If the outer extremes of a swath need to be "removed" (as the term "clip" would imply), that should be handled by flagging those points with the Withheld Flag. That is what the Withheld Flag has always been intended to signify. Why it has been so widely ignored (pun intended) is a topic for a completely different rant. ;-)

Thanks Evon!
See you in Ft. Worth?

Karl



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Mon, Mar 14, 2016 at 10:57 AM

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Evon

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Evon Silvia <esilvia@quantumspatial.com>

Mon, Mar 14, 2016 at 10:58 AM

To: "Heidemann, Hans" <kheidemann@usgs.gov>

I hadn't originally planned to go to the ASPRS conference, but apparently everyone will be there and I didn't get to meet you at ILMF! I'll look into getting some time down there.

Evon

[Quoted text hidden]

Heidemann, Hans <kheidemann@usgs.gov>

Mon, Mar 14, 2016 at 11:16 AM

To: Evon Silvia <esilvia@quantumspatial.com>

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and using the Withheld Flag for the outer points still retains the edge points so, even though they would be also flagged as withheld, you are not prevented from building those polygons.

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[Quoted text hidden]

Heidemann, Hans <kheidemann@usgs.gov>

Mon, Mar 14, 2016 at 11:17 AM

To: Evon Silvia <esilvia@quantumspatial.com>

It would be good to meet face2face. I enjoy and value your insights into "the other side" of our industry.

Karl



H. Karl Heidemann, GISP, CMS

Physical Scientist, Lidar Science

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Christian Sevcik <csevci@riegl.com>

Tue, Mar 15, 2016 at 1:33 AM

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Karl,

Evon,

Thanks for the input. This sounds good to me.

I get your arguments of either flagging single and first or single and last returns, or alternating at the beginning and end of a scanline.

Would you expect flagged points at every single scan line?

I am thinking of datasets filtered for certain purpose, for instance single and last returns for DTM creation, or single and first for DSM. In this case some of the flagged points won't make it to the LAS file. So you end up with some lines fully flagged, some partially and maybe some not flagged at all. Very likely there are still enough points to calculate for a fairly good boundary, but it is definitely not a perfect fit. Any concerns here?

Thanks

Christian

DI Christian Sevcik

Manager | Strategic Software Alliances



RIEGL Laser Measurement Systems GmbH

Riedenburgstrasse 48, 3580 Horn, Austria

Phone: +43-2982-4211

Fax: +43-2982-4210

e-mail: csevcik@riegl.com

www: <http://www.riegl.com>

Von: Heidemann, Hans [<mailto:kheidemann@usgs.gov>]

Gesendet: Montag, 14. März 2016 19:16

An: Evon Silvia

Cc: Christian Sevcik; Lewis Graham; Michael Rosen; sdharnapuri@mbakercorp.com; Wanning Peng; Arttu Soininen; Christopher Parrish; David Reid; Derek Morris; Gerhard Loeffler; Howard Butler; Martin Isenburg (martin.isenburg@gmail.com); Mike Umansky; Paul Galla

Betreff: Re: US - Las Working Group - Edge of Flightline flag

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Tue, Mar 15, 2016 at 9:40 AM

To: Christian Sevcik <csevcik@riegl.com>

Cc: "Heidemann, Hans" <kheidemann@usgs.gov>, Lewis Graham <lgraham@geocue.com>, Michael Rosen <mrosen@lizardtech.com>, "sdharmapuri@mbakercorp.com" <sdharmapuri@mbakercorp.com>, Wanning Peng <wpeng@esri.com>, Arttu Soininen <arttu.soininen@kolumbus.fi>, Christopher Parrish <Christopher.Parrish@oregonstate.edu>, David Reid <david.reid@optech.com>, Derek Morris <dmorris@geocue.com>, Gerhard Loeffler <Gerhard_Loeffler@trimble.com>, Howard Butler <hobu.inc@gmail.com>, "Martin Isenburg (martin.isenburg@gmail.com)" <martin.isenburg@gmail.com>, Mike Umansky <mumansky@appliedimagery.com>, Paul Galla <paul.galla@leicaus.com>

Christian,

I would think that it depends on which data you're talking about. Generally, for filtering in post-processing software like LAsTools, TerraSolid, GeoCue, LP360, RiProcess, etc, I wouldn't expect those software packages to re-apply the edge flag unless they're running a routine designed for that purpose. That would be a nearly impossible expectation to meet, especially on tiled data.

The discussion gets more interesting for the software producing/extracting swaths from the raw sensor data – in your case, RiAnalyze probably. In that case, the software should be producing edge flags on every line because the user would reasonably expect valid data straight from the sensor. Consider this example, arbitrary swath:



If I extract every point, I would expect RiAnalyze to correctly apply edge flags to the orange points on the ends of every line.

But what if a filter is being applied in the extraction software, though? For example, a 2° edge clip would remove the orange and green points, leaving just the black and red. Should the red be flagged as edge? Well... I waffled back and forth about 8 times while writing this email so I honestly don't know. I wouldn't *expect* the edge flags, but they would still be useful in both cases for all the same reasons that they were useful in the first place. I can't think of a reason *not* to flag them, except in the unusual circumstance where you want to merge clipped and unclipped data... which I've had to do a several times recently. Maybe make it optional?

For another example, if I only extracted every 5th pulse for faster quicklooking, the original right-hand edge point would be lost.



Should the red point be flagged as an edge? I'm not sure, but probably not in this case. Final data is very rarely produced in this way as far as I know. For the example that you proposed of filtering based on return, I probably wouldn't expect edge flags.

This is very similar to the question of what should be done after running an atmospheric noise filter. If I have 5 returns and I filter out the first 2, should I renumber the returns so that they are "x of 3" instead of "x of 5"? Most people don't, even though there are now only 3 points in the pulse. **If you never actually remove the data and only classify it like Karl insists, this entire discussion is completely moot.** In my opinion, questions like these are the best reason to deliver all data and use Withheld flags. (Tangent: If manufacturers added an option to FLAG clipped points as Withheld instead of removing it, that would make the lives of data vendors immensely easier, as Karl's preference is a requirement for all 3DEP contracts.)

In the end, I think my answer is that users would expect edge flags on both ends of every line unless a filter is applied. For filtered data, it's up to the user to add edge flags. The notable exception for me is when applying an edge clip, in which case I would leave it up to the user.

The others on this list are invited to disagree. :)

Evon

--



Evon Silvia PLS
Geomatics Specialist
517 SW 2nd Street, Suite 400, Corvallis, OR 97333
P: (541) 452-8502
E: esilvia@quantumspatial.com

[Quoted text hidden]

Christian Sevcik <csevcik@riegl.com>

Wed, Mar 16, 2016 at 1:41 AM

To: Evon Silvia <esilvia@quantumspatial.com>

Cc: "Heidemann, Hans" <kheidemann@usgs.gov>, Lewis Graham <lgraham@geocue.com>, Michael Rosen <mrosen@lizardtech.com>, "sdharmapuri@mbakercorp.com" <sdharmapuri@mbakercorp.com>, Wanning Peng <wpeng@esri.com>, Arttu Soininen <arttu.soininen@kolumbus.fi>, Christopher Parrish <Christopher.Parrish@oregonstate.edu>, David Reid <david.reid@optech.com>, Derek Morris <dmorris@geocue.com>, Gerhard Loeffler <Gerhard_Loeffler@trimble.com>, Howard Butler <hobu.inc@gmail.com>, "Martin Isenburg (martin.isenburg@gmail.com)" <martin.isenburg@gmail.com>, Mike Umansky <mumansky@appliedimagery.com>, Paul Galla <paul.galla@leicaus.com>

Evon,

Thanks a lot for your reply. It is a bit of an eye opener, as it seems we are looking at the same topic from different angles.

Our workflow is somewhere between the scanner and the LAS file, therefore some processing in terms of filtering, cleaning, maybe thinning, clipping, merging,... is happening to the data before it is written to a LAS for the first time. In my understanding the characteristics, which qualify a point as edge of flight line are set during acquisition and due to some of processing steps mentioned above, probably not survive until the LAS file is written.

The discussion with you guys shed some light on the topic and I will definitely share this with our developers.

Thank you!

Christian

DI Christian Sevcik

Manager | Strategic Software Alliances

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Heidemann, Hans <kheidemann@usgs.gov>

Wed, Mar 16, 2016 at 9:03 AM

To: Christian Sevcik <csevcik@riegl.com>

Cc: Evon Silvia <esilvia@quantumspatial.com>, Lewis Graham <lgraham@geocue.com>, Michael Rosen <mrosen@lizardtech.com>, "sdharmapuri@mbakercorp.com" <sdharmapuri@mbakercorp.com>, Wanning Peng <wpeng@esri.com>, Arttu Soininen <arttu.soininen@kolumbus.fi>, Christopher Parrish <Christopher.Parrish@oregonstate.edu>, David Reid <david.reid@optech.com>, Derek Morris <dmorris@geocue.com>, Gerhard Loeffler <Gerhard_Loeffler@trimble.com>, Howard Butler <hobu.inc@gmail.com>, "Martin Isenburg (martin.isenburg@gmail.com)" <martin.isenburg@gmail.com>, Mike Umansky <mumansky@appliedimagery.com>, Paul Galla <paul.galla@leicaus.com>

Thank you Evon.

Christian,

We (the industry) struggled with points in separate files for too many years. I for one do not want to go back and I have worked mighty hard over my career to help develop LAS and ensure that software has been developed such that maximum advantage of point cloud data can be leveraged.

You mention that potentially ["... filtering, cleaning, maybe thinning, clipping, merging,... is happening to the data before it is written to a LAS for the first time."](#)

I find this troubling as it imposes irreversible limitations on the data to the end user - the people who are paying for the data. I won't argue that many, many end users may truly only want derivative products, but others want and need the entire "raw" point cloud for their work. Without it, the industry and entire geospatial community is locked into the black-box derivative products that vendors provide, and further research into the wealth of information that point clouds hold is hobbled.

As we stress in the our Lidar Base Specification, the USGS regards the full and complete point cloud as the primary data deliverable for a lidar collection. We are paying for a collection; we want the data that has been collected. DEMs, DSMs, Intensity Images -- these are derivative products.

It is my view, overly simplified and perhaps narrowly perceived, that as swaths of point data come out of manufacturers' pre-processing software, proper geometric corrections should have been applied, edge flags assigned, and geometrically unreliable points (those clearly blunderous points outside the rational 3D extents of the swath - either horizontally or vertically, and near-edge points) will have been flagged as Withheld. Minor geometric corrections *to swaths* may be applied to the outputted LAS point cloud files. I *personally* do not favor methods that apply geometric corrections after swaths have been combined and tiled. That said, I fully realize that different data producers use different techniques, and I accept and allow that the proof has to be in the delivered data. But regardless of how good that data is, we here have a responsibility to know more about it's lineage -- kinda like knowing your fancy restaurant dinner has no allergens or GMOs in it. Doesn't mean you won't eat it, but you have to know. This is why we require delivery of full, complete swaths -- in their final geometry -- as a principle deliverable.

As most of the recipients here are aware, I am still on my overarching, seemingly life-long crusade to move the industry past the entire tiling debacle with the development of full end-to-end swath-based lidar production, processing, and exploitation software. We are all wasting mountains of time and money on tiles. Obviously, the requirements and "standards" we have established thus far are critical foundation pieces for that goal.

Karl



H. Karl Heidemann, GISP, CMS

Physical Scientist, Lidar Science

U.S. Geological Survey

Mundt Federal Building

47914 252nd Street

Sioux Falls, SD 57198

605-594-2861

kheidemann@usgs.gov

*"Nothing matters very much, and very few things ... matter at all."
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[Quoted text hidden]

Christian Sevcik <csevcik@riegl.com>

Wed, Mar 16, 2016 at 9:39 AM

To: "Heidemann, Hans" <kheidemann@usgs.gov>

Cc: Evon Silvia <esilvia@quantumspatial.com>, Lewis Graham <lgraham@geocue.com>, Michael Rosen <mrosen@lizardtech.com>, "sdharmapuri@mbakercorp.com" <sdharmapuri@mbakercorp.com>, Wanning Peng <wpeng@esri.com>, Arttu Soininen <arttu.soininen@kolumbus.fi>, Christopher Parrish <Christopher.Parrish@oregonstate.edu>, David Reid <david.reid@optech.com>, Derek Morris <dmorris@geocue.com>, Gerhard Loeffler <Gerhard_Loeffler@trimble.com>, Howard Butler <hobu.inc@gmail.com>, "Martin Isenburg (martin.isenburg@gmail.com)" <martin.isenburg@gmail.com>, Mike Umansky <mumansky@appliedimagery.com>, Paul Galla <paul.galla@leicaus.com>

Karl,

I get your point and I probably did not make myself clear enough. The software processes the data with parameters controlled by the user. If a full unfiltered,... all the things you put in blue below.. is required, it can be done. It is not a black box, out of control processing engine. So, if you order the data from your service provider with no processing applied, it is perfectly possible.

But I know people are using the software to further process the data and create some kind of deliverables. And this includes thinning, clipping, merging,..., so we have to provide these functions. But again, it is the user who controls the amount of processing applied to the data.

This makes sense?

Christian

DI Christian Sevcik

Manager | Strategic Software Alliances



RIEGL Laser Measurement Systems GmbH

Riedenburgstrasse 48, 3580 Horn, Austria

Phone: +43-2982-4211

Fax: +43-2982-4210

e-mail: csevcik@riegl.com

www: <http://www.riegl.com>

Von: Heidemann, Hans [mailto:kheidemann@usgs.gov]

Gesendet: Mittwoch, 16. März 2016 17:03

An: Christian Sevcik

Cc: Evon Silvia; Lewis Graham; Michael Rosen; sdharmapuri@mbakercorp.com; Wanning Peng; Arttu Soinen; Christopher Parrish; David Reid; Derek Morris; Gerhard Loeffler; Howard Butler; Martin Isenburg (martin.isenburg@gmail.com); Mike Umansky; Paul Galla

Betreff: Re: US - Las Working Group - Edge of Flightline flag

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Karl

 **H. Karl Heidemann, GISP, CMS**

[Quoted text hidden]

[Quoted text hidden]

Heidemann, Hans <kheidemann@usgs.gov>

Wed, Mar 16, 2016 at 10:02 AM

To: Christian Sevcik <csevcik@riegl.com>

Cc: Evon Silvia <esilvia@quantumspatial.com>, Lewis Graham <lgraham@geocue.com>, Michael Rosen <mrosen@lizardtech.com>, "sdharmapuri@mbakercorp.com" <sdharmapuri@mbakercorp.com>, Wanning Peng <wpeng@esri.com>, Arttu Soinen <arttu.soininen@kolumbus.fi>, Christopher Parrish <Christopher.Parrish@oregonstate.edu>, David Reid <david.reid@optech.com>, Derek Morris <dmorris@geocue.com>, Gerhard Loeffler <Gerhard_Loeffler@trimble.com>, Howard Butler <hobu.inc@gmail.com>, "Martin Isenburg (martin.isenburg@gmail.com)" <martin.isenburg@gmail.com>, Mike Umansky <mumansky@appliedimagery.com>, Paul Galla <paul.galla@leicaus.com>

It makes perfect sense Christian, and I know that Riegl has lots of non-US customers whose requirements differ greatly from ours. While I naturally think our way is best, those of your customers are well off my radar. But I do need to be clear about USGS acceptance criteria (and the rationale behind them), as a mighty fair chunk of US data is tied to USGS funding and requirements.

Karl



H. Karl Heidemann, GISP, CMS

Physical Scientist, Lidar Science

U.S. Geological Survey

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47914 252nd Street

Sioux Falls, SD 57198

605-594-2861

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"Nothing matters very much, and very few things ... matter at all."

- Arthur James Balfour

[Quoted text hidden]

Lewis Graham <lgraham@geocue.com>

Wed, Mar 23, 2016 at 5:29 AM

To: Christian Sevcik <csevcik@riegl.com>, "Heidemann, Hans" <kheidemann@usgs.gov>

Cc: Evon Silvia <esilvia@quantumspatial.com>, Michael Rosen <mrosen@lizardtech.com>, "sdharmapuri@mbakercorp.com" <sdharmapuri@mbakercorp.com>, Wanning Peng <wpeng@esri.com>, Arttu Soininen <arttu.soininen@kolumbus.fi>, Christopher Parrish <Christopher.Parrish@oregonstate.edu>, David Reid <david.reid@optech.com>, Derek Morris <dmorris@geocue.com>, Gerhard Loeffler <Gerhard_Loeffler@trimble.com>, Howard Butler <hobu.inc@gmail.com>, "Martin Isenburg (martin.isenburg@gmail.com)" <martin.isenburg@gmail.com>, Mike Umansky <mumansky@appliedimagery.com>, Paul Galla <paul.galla@leicaus.com>

Just a bit (pun intended) of history –

When we did the very first LAS (prior to it being turned over to the ASPRS), the “edge of swath” bit was intended to allow a user to trim “bad” data.

As you probably recall, the oscillating scanners used to be unreliable from the perspective of position encoding during mirror reversal.

The idea was that one could detect the edge of scan pulse, look up the GPS time stamp and then remove points near this point with near meaning from the time perspective (you could not do it from position due to the encoder issues).

There were all sorts of “best practice” approaches such as to routinely clip x% at the edge of swath and so forth.

Of course, the correct answer was that the manufacture should remove known bad data prior to the first encoding and that, I think, is where things went.

So the edge of scan is an old artifact of a bad practice we were all engaged in back in the early days when the sensors were still really somewhat experimental.

Perhaps we could simply redefine this as “edge of swath” and use it for generating coverage polygons. If it gets clipped out in a thinning/clipping process, then we should not worry about it.

An alternative is to simply deprecate it entirely.

Regards,

Lewis

Lewis Graham

GeoCue Group

9668 Madison Blvd., Suite 202

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01-256-461-8289

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From: Christian Sevcik [mailto:csevcik@riegl.com]
Sent: Wednesday, March 16, 2016 11:40
To: Heidemann, Hans <kheidemann@usgs.gov>
Cc: Evon Silvia <esilvia@quantumspatial.com>; Lewis Graham <lgraham@geocue.com>; Michael Rosen <mrosen@lizardtech.com>; sdharmapuri@mbakercorp.com; Wanning Peng <wpeng@esri.com>; Arttu Soininen <arttu.soininen@kolumbus.fi>; Christopher Parrish <Christopher.Parrish@oregonstate.edu>; David Reid <david.reid@optech.com>; Derek Morris <dmorris@geocue.com>; Gerhard Loeffler <Gerhard_Loeffler@trimble.com>; Howard Butler <hobu.inc@gmail.com>; Martin Isenburg <martin.isenburg@gmail.com> <martin.isenburg@gmail.com>; Mike Umansky <mumansky@appliedimagery.com>; Paul Galla <paul.galla@leicaus.com>
Subject: AW: US - Las Working Group - Edge of Flightline flag

[Quoted text hidden]

Evon Silvia <esilvia@quantumspatial.com> Wed, Mar 23, 2016 at 8:40 AM
To: Lewis Graham <lgraham@geocue.com>
Cc: Christian Sevcik <csevcik@riegl.com>, "Heidemann, Hans" <kheidemann@usgs.gov>, Michael Rosen <mrosen@lizardtech.com>, "sdharmapuri@mbakercorp.com" <sdharmapuri@mbakercorp.com>, Wanning Peng <wpeng@esri.com>, Arttu Soininen <arttu.soininen@kolumbus.fi>, Christopher Parrish <Christopher.Parrish@oregonstate.edu>, David Reid <david.reid@optech.com>, Derek Morris <dmorris@geocue.com>, Gerhard Loeffler <Gerhard_Loeffler@trimble.com>, Howard Butler <hobu.inc@gmail.com>, "Martin Isenburg <martin.isenburg@gmail.com>" <martin.isenburg@gmail.com>, Mike Umansky <mumansky@appliedimagery.com>, Paul Galla <paul.galla@leicaus.com>

Thanks for the background, Lewis. On thing to note is that our experience is that the issue of poor geometry at the swath edges is still a very real and present problem in high resolution and high accuracy LiDAR, both for the oscillating mirror and rotating prism scanners. You are correct, though, that newer scanners have reduced this error significantly over previous generations. My theory is that the error we are observing has everything to do with the obliqueness as you get further off-nadir, rather than the mechanical properties of the scanner itself like with previous generations.

Still, my point is that this isn't just a problem left in the history books and remains relevant with current technology. In fact, I've spent the past 3 days improving our edge filtering algorithms...

Evon

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Evon Silvia PLS
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517 SW 2nd Street, Suite 400, Corvallis, OR 97333
P: (541) 452-8502
E: esilvia@quantumspatial.com

[Quoted text hidden]

Lewis Graham <lgraham@geocue.com>

Sun, Mar 27, 2016 at 5:56 AM

To: Evon Silvia <esilvia@quantumspatial.com>

Hi Evon,

Stating the obvious but if it is mirror shape, it can be calibrated. Sounds like you have a bad set of calibration data in the sensor post-processing stage (which I know you already know!).

Lewis Graham

AirGon LLC

sUAS Mapping Solutions

A subsidiary of **GeoCue Group**

9668 Madison Blvd., Suite 202

Madison, AL USA 35758

01-256-461-8289

lgraham@AirGon.com

www.AirGon.com

From: Evon Silvia [mailto:esilvia@quantumspatial.com]

Sent: Wednesday, March 23, 2016 10:41

To: Lewis Graham <lgraham@geocue.com>

Cc: Christian Sevcik <csevcik@riegl.com>; Heidemann, Hans <kheidemann@usgs.gov>; Michael Rosen <mrosen@lizardtech.com>; sdharmapuri@mbakercorp.com <sdharmapuri@mbakercorp.com>; Wanning Peng <wpeng@esri.com>; Arttu Soininen <arttu.soininen@kolumbus.fi>; Christopher Parrish <Christopher.Parrish@oregonstate.edu>; David Reid <david.reid@optech.com>; Derek Morris <dmorris@geocue.com>; Gerhard Loeffler <Gerhard_Loeffler@trimble.com>; Howard Butler <hobu.inc@gmail.com>; Martin Isenburg (martin.isenburg@gmail.com) <martin.isenburg@gmail.com>; Mike Umansky <mumansky@appliedimagery.com>; Paul Galla <paul.galla@leicaus.com>

Subject: Re: US - Las Working Group - Edge of Flightline flag

[Quoted text hidden]

Christian Sevcik <csevcik@riegl.com>

Tue, Mar 29, 2016 at 4:55 AM

To: Evon Silvia <esilvia@quantumspatial.com>, Lewis Graham <lgraham@geocue.com>

Cc: "Heidemann, Hans" <kheidemann@usgs.gov>, Michael Rosen <mrosen@lizardtech.com>, "sdharmapuri@mbakercorp.com" <sdharmapuri@mbakercorp.com>, Wanning Peng <wpeng@esri.com>, Arttu Soininen <arttu.soininen@kolumbus.fi>, Christopher Parrish <Christopher.Parrish@oregonstate.edu>, David Reid <david.reid@optech.com>, Derek Morris <dmorris@geocue.com>, Gerhard Loeffler <Gerhard_Loeffler@trimble.com>, Howard Butler <hobu.inc@gmail.com>, "Martin Isenburg (martin.isenburg@gmail.com)" <martin.isenburg@gmail.com>, Mike Umansky <mumansky@appliedimagery.com>, Paul Galla <paul.galla@leicaus.com>

Thank you all for sharing the insights.

From what was discussed here, we found it is best to flag single and last returns on the left and right edge of the swath.

Christian

DI Christian Sevcik

Manager | Strategic Software Alliances



RIEGL Laser Measurement Systems GmbH

Riedenburgstrasse 48, 3580 Horn, Austria

Phone: +43-2982-4211

Fax: +43-2982-4210

e-mail: csevcik@riegl.com

www: <http://www.riegl.com>

Von: Evon Silvia [mailto:esilvia@quantumspatial.com]

Gesendet: Mittwoch, 23. März 2016 16:41

An: Lewis Graham

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Sent: Wednesday, March 16, 2016 11:40

To: Heidemann, Hans <kheidemann@usgs.gov>

Cc: Evon Silvia <esilvia@quantumspatial.com>; Lewis Graham <lgraham@geocue.com>; Michael Rosen <mrosen@lizardtech.com>; sdharmapuri@mbakercorp.com; Wanning Peng <wpeng@esri.com>; Arttu Soinen <arttu.soininen@kolumbus.fi>; Christopher Parrish <Christopher.Parrish@oregonstate.edu>; David Reid <david.reid@optech.com>; Derek Morris <dmorris@geocue.com>; Gerhard Loeffler <Gerhard_Loeffler@trimble.com>; Howard Butler <hobu.inc@gmail.com>; Martin Isenburg (martin.isenburg@gmail.com) <martin.isenburg@gmail.com>; Mike Umansky <mumansky@appliedimagery.com>; Paul Galla <paul.galla@leicaus.com>

Subject: AW: US - Las Working Group - Edge of Flightline flag

Karl,

I get your point and I probably did not make myself clear enough. The software processes the data with parameters controlled by the user. If a full unfiltered,... all the things you put in blue below.. is required, it can be done. It is not a black box, out of control processing engine. So, if you order the data from your service provider with no processing applied, it is perfectly possible.

But I know people are using the software to further process the data and create some kind of deliverables. And this includes thinning, clipping, merging,..., so we have to provide these functions. But again, it is the user who controls the amount of processing applied to the data.

This makes sense?

Christian

DI Christian Sevcik

Manager | Strategic Software Alliances



RIEGL Laser Measurement Systems GmbH

Riedenburgstrasse 48, 3580 Horn, Austria

Phone: +43-2982-4211

Fax: +43-2982-4210

e-mail: csevcik@riegl.comwww: <http://www.riegl.com>**Von:** Heidemann, Hans [<mailto:kheidemann@usgs.gov>]**Gesendet:** Mittwoch, 16. März 2016 17:03**An:** Christian Sevcik**Cc:** Evon Silvia; Lewis Graham; Michael Rosen; sdharmapuri@mbakercorp.com; Wanning Peng; Arttu Soinen; Christopher Parrish; David Reid; Derek Morris; Gerhard Loeffler; Howard Butler; Martin Isenburg (martin.isenburg@gmail.com); Mike Umansky; Paul Galla**Betreff:** Re: US - Las Working Group - Edge of Flightline flag

Thank you Evon.

Christian,

We (the industry) struggled with points in separate files for too many years. I for one do not want to go back and I have worked mighty hard over my career to help develop LAS and ensure that software has been developed such that maximum advantage of point cloud data can be leveraged.

You mention that potentially "... filtering, cleaning, maybe thinning, clipping, merging,... is happening to the data before it is written to a LAS for the first time."

I find this troubling as it imposes irreversible limitations on the data to the end user - the people who are paying for the data. I won't argue that many, many end users may truly only want derivative products, but others want and need the entire "raw" point cloud for their work. Without it, the industry and entire geospatial community is locked into

the black-box derivative products that vendors provide, and further research into the wealth of information that point clouds hold is hobbled.

As we stress in the our Lidar Base Specification, the USGS regards the full and complete point cloud as the primary data deliverable for a lidar collection. We are paying for a collection; we want the data that has been collected. DEMs, DSMs, Intensity Images -- these are derivative products.

It is my view, overly simplified and perhaps narrowly perceived, that as swaths of point data come out of manufacturers' pre-processing software, proper geometric corrections should have been applied, edge flags assigned, and geometrically unreliable points (those clearly blunderous points outside the rational 3D extents of the swath - either horizontally or vertically, and near-edge points) will have been flagged as Withheld. Minor geometric corrections *to swaths* may be applied to the outputted LAS point cloud files. I *personally* do not favor methods that apply geometric corrections after swaths have been combined and tiled. That said, I fully realize that different data producers use different techniques, and I accept and allow that the proof has to be in the delivered data. But regardless of how good that data is, we here have a responsibility to know more about it's lineage -- kinda like knowing your fancy restaurant dinner has no allergens or GMOs in it. Doesn't mean you won't eat it, but you have to know. This is why we require delivery of full, complete swaths -- in their final geometry -- as a principle deliverable.

As most of the recipients here are aware, I am still on my overarching, seemingly life-long crusade to move the industry past the entire tiling debacle with the development of full end-to-end swath-based lidar production, processing, and exploitation software. We are all wasting mountains of time and money on tiles. Obviously, the requirements and "standards" we have established thus far are critical foundation pieces for that goal.

Karl

 **H. Karl Heidemann, GISP, CMS**

Physical Scientist, Lidar Science

U.S. Geological Survey

Mundt Federal Building

47914 252nd Street

Sioux Falls, SD 57198

[605-594-2861](tel:605-594-2861)

kheidemann@usgs.gov

"Nothing matters very much, and very few things ... matter at all."

- Arthur James Balfour

On Wed, Mar 16, 2016 at 3:41 AM, Christian Sevcik <csevcik@riegl.com> wrote:

Evon,

Thanks a lot for your reply. It is a bit of an eye opener, as it seems we are looking at the same topic from different angles.

Our workflow is somewhere between the scanner and the LAS file, therefore some processing in terms of filtering, cleaning, maybe thinning, clipping, merging,... is happening to the data before it is written to a LAS for the first time. In my understanding the characteristics, which qualify a point as edge of flight line are set during acquisition and due to some of processing steps mentioned above, probably not survive until the LAS file is written.

The discussion with you guys shed some light on the topic and I will definitely share this with our developers.

Thank you!

Christian

DI Christian Sevcik

Manager | Strategic Software Alliances



RIEGL Laser Measurement Systems GmbH

Riedenburgstrasse 48, 3580 Horn, Austria

Phone: +43-2982-4211

Fax: +43-2982-4210

e-mail: csevcik@riegl.com

www: <http://www.riegl.com>

Von: Evon Silvia [mailto:esilvia@quantumspatial.com]

Gesendet: Dienstag, 15. März 2016 17:41

An: Christian Sevcik

Cc: Heidemann, Hans; Lewis Graham; Michael Rosen; sdharmapuri@mbakercorp.com; Wanning Peng; Arttu Soinenen; Christopher Parrish; David Reid; Derek Morris; Gerhard Loeffler; Howard Butler; Martin Isenburg (martin.isenburg@gmail.com); Mike Umansky; Paul Galla

Betreff: Re: US - Las Working Group - Edge of Flightline flag

Christian,

I would think that it depends on which data you're talking about. Generally, for filtering in post-processing software like LAStools, TerraSolid, GeoCue, LP360, RiProcess, etc, I wouldn't expect those software packages to re-apply the edge flag unless they're running a routine designed for that purpose. That would be a nearly impossible expectation to meet, especially on tiled data.

The discussion gets more interesting for the software producing/extracting swaths from the raw sensor data – in your case, RiAnalyze probably. In that case, the software should be producing edge flags on every line because the user would reasonably expect valid data straight from the sensor. Consider this example, arbitrary swath:



If I extract every point, I would expect RiAnalyze to correctly apply edge flags to the orange points on the ends of every line.

But what if a filter is being applied in the extraction software, though? For example, a 2° edge clip would remove the orange and green points, leaving just the black and red. Should the red be flagged as edge? Well... I waffled back and forth about 8 times while writing this email so I honestly don't know. I wouldn't *expect* the edge flags, but they would still be useful in both cases for all the same reasons that they were useful in the first place. I can't think of a reason *not* to flag them, except in the unusual circumstance where you want to merge clipped and unclipped data... which I've had to do a several times recently. Maybe make it optional?

For another example, if I only extracted every 5th pulse for faster quicklooking, the original right-hand edge point would be lost.



Should the red point be flagged as an edge? I'm not sure, but probably not in this case. Final data is very rarely produced in this way as far as I know. For the example that you proposed of filtering based on return, I probably wouldn't expect edge flags.

This is very similar to the question of what should be done after running an atmospheric noise filter. If I have 5 returns and I filter out the first 2, should I renumber the returns so that they are "x of 3" instead of "x of 5"? Most people don't, even though there are now only 3 points in the pulse. **If you never actually remove the data and only classify it like Karl insists, this entire discussion is completely moot.** In my opinion, questions like these are the best reason to deliver all data and use Withheld flags. (Tangent: If manufacturers added an option to FLAG clipped points as Withheld instead of removing it, that would make the lives of data vendors immensely easier, as Karl's preference is a requirement for all 3DEP contracts.)

In the end, I think my answer is that users would expect edge flags on both ends of every line unless a filter is applied. For filtered data, it's up to the user to add edge flags. The notable exception for me is when applying an edge clip, in which case I would leave it up to the user.

The others on this list are invited to disagree. :)

Evon

--

Evon Silvia PLS
Geomatics Specialist
517 SW 2nd Street, Suite 400, Corvallis, OR 97333
P: (541) 452-8502

E: esilvia@quantumspatial.com

On Tue, Mar 15, 2016 at 1:33 AM, Christian Sevcik <csevcik@riegl.com> wrote:

Karl,

Evon,

Thanks for the input. This sounds good to me.

I get your arguments of either flagging single and first or single and last returns, or alternating at the beginning and end of a scanline.

Would you expect flagged points at every single scan line?

I am thinking of datasets filtered for certain purpose, for instance single and last returns for DTM creation, or single and first for DSM. In this case some of the flagged points won't make it to the LAS file. So you end up with some lines

fully flagged, some partially and maybe some not flagged at all. Very likely there are still enough points to calculate for a fairly good boundary, but it is definitely not a perfect fit. Any concerns here?

Thanks

Christian

DI Christian Sevcik

Manager | Strategic Software Alliances



RIEGL Laser Measurement Systems GmbH

Riedenburgstrasse 48, 3580 Horn, Austria

Phone: +43-2982-4211

Fax: +43-2982-4210

e-mail: csevcik@riegl.com

www: <http://www.riegl.com>

Von: Heidemann, Hans [<mailto:kheidemann@usgs.gov>]

Gesendet: Montag, 14. März 2016 19:16

An: Evon Silvia

Cc: Christian Sevcik; Lewis Graham; Michael Rosen; sdharmapuri@mbakercorp.com; Wanning Peng; Arttu Soininen; Christopher Parrish; David Reid; Derek Morris; Gerhard Loeffler; Howard Butler; Martin Isenburg (martin.isenburg@gmail.com); Mike Umansky; Paul Galla

Betreff: Re: US - Las Working Group - Edge of Flightline flag

and using the Withheld Flag for the outer points still retains the edge points so, even though they would be also flagged as withheld, you are not prevented from building those polygons.

Karl

H. Karl Heidemann, GISP, CMS

Physical Scientist, Lidar Science

U.S. Geological Survey

Mundt Federal Building

47914 252nd Street

Sioux Falls, SD 57198

605-594-2861

kheidemann@usgs.gov

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On Mon, Mar 14, 2016 at 12:57 PM, Evon Silvia <esilvia@quantumspatial.com> wrote:

Good point on the value on simply having a point on either edge of the swath. Coverage polygons would be so much easier if the edge flag was properly encoded all the time and no points were ever deleted.

Evon

On Mon, Mar 14, 2016 at 9:14 AM, Heidemann, Hans <kheidemann@usgs.gov> wrote:

lol

And I would not disagree with Evon on his point about the Last Return over First return. In most all cases, it really doesn't matter all that much. Evon knows considerably more than I do about internal coding nuances.

I would disagree on the point of the edge flag. In my mind, the point is, as Christian initially asserted, to more easily identify a precise edge of the swath data. My biggest concern is, perhaps, a semantic one: Evon stated that it allows a simpler means to "clip" the edges. The term "clip" is too often understood to mean "remove" -- this approach is wholly unacceptable. If the outer extremes of a swath need to be "removed" (as the term "clip" would imply), that should be handled by flagging those points with the Withheld Flag. That is what the Withheld Flag has always been intended to signify. Why it has been so widely ignored (pun intended) is a topic for a completely different rant. ;-)

Thanks Evon!
See you in Ft. Worth?

Karl

H. Karl Heidemann, GISP, CMS

Physical Scientist, Lidar Science

U.S. Geological Survey

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On Mon, Mar 14, 2016 at 11:01 AM, Evon Silvia <esilvia@quantumspatial.com> wrote:

Hello Christian,

I agree with Karl on all points, except a minor point for Question 3: I would suggest flagging the LAST return for the final pulse to hit a particular face and the FIRST return of the first pulse to hit a face. Most sorting algorithms would sort points in that manner (chronologically by timestamp, then by return), so that would ensure adjacency.

The point of the edge flag is to give users the ability to conveniently "clip" the edges of a flightline for whatever reason they deem worthy. Two examples off the top of my head include geometric distortion at flightline edges and clipping/flagging/filtering overlap areas for setting the Overlap bit. This procedure is significantly simplified by the addition of a Edge Flag.

Great question! Definitely a point that can be clarified in the spec. I don't believe there was any intent to change the definition of the Edge Flag between the point formats.

Evon

--

Evon Silvia PLS
Geomatics Specialist

517 SW 2nd Street, Suite 400, Corvallis, OR 97333

P: (541) 452-8502

E: esilvia@quantumspatial.com



On Mon, Mar 14, 2016 at 8:54 AM, Heidemann, Hans <kheidemann@usgs.gov> wrote:

H Christian,

This is only my opinion and may not represent even a plurality of the committee.

Question 1: It seems to me that, if you can flag the last point of a rotating polygon scanline, it should not be overly difficult to flag the next point, which would be the first point of the next scanline ? Perhaps not; I don't claim to know the internal intricacies of your system processing.

Question 2: I would think that the split between forward and reverse arcs would/should provide a very close approximation of the edges of the swath. Obviously, variations in flight attitude will prevent this from being an absolutely exact boundary, but the same limitation exists for all systems.

Question 3: I would suggest flagging the First Return. Yes, on the outbound scan, there may likely be additional points beyond the First, but the opposite will happen on the inbound scan as well, so it's a pick your poison kind of question. The difference is not likely to be significant either way, flagging the First seems like it would be simpler. Flagging all returns of the pulse is likely to cause further complexity in downstream processing for MOST processes; the additional effort should be placed on the fewer activities that would benefit from that scheme.

Karl

H. Karl Heidemann, GISP, CMS

Physical Scientist, Lidar Science

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On Mon, Mar 14, 2016 at 9:29 AM, Christian Sevcik <csevcik@riegl.com> wrote:

Hello LWG,

We received a request to populate the edge of flight line flag.

According to the standard - I refer to las specification version 1.4 r13, July 2013- the flag is defined as:

For point data records 0-5

"Edge of Flight Line: The Edge of Flight Line data bit has a value of 1 only when the point is at the end of a scan. It is the last point on a given scan line before it changes direction."

For point data records 6-10

"Edge of Flight Line: The Edge of Flight Line data bit has a value of 1 only when the point is at the end of a scan. It is the last point on a given scan line before it changes direction or the mirror facet changes. Note that this field has no meaning for 360° Field of View scanners (such as Mobile LIDAR scanners) and should not be set."

This brings up 3 questions and I wonder, if there is consent within the group ;-)

Definition 1 can only apply to oscillating mirror scanners, as there is no change in direction for a rotating polygon wheel mirror scanners.

This also means that there is no edge of flightline flag in LAS files version 1.1 -1.3 for polygon wheel scanners.

Definition 2 explicitly addresses facet change and therefore allows to set this flag for polygon wheel scanners for LAS 1.4 and point data record format 6 -10.

As it is stated, only the last point before a facet change can be flagged as edge of flight line, 'edge points' are created on one side of the flight line only. As I understand the intention of the flag is to quickly calculate for the ground coverage of a flightline, but we seem to get stuck here.

Question 2 is about circular scan patterns. There is neither a change in direction, nor a change of facet. For computational reasons we split a circle into a forward arc and a backward arc. Would it be safe to introduce such artificial edges?

The third question is about the returns to be flagged. Although it is not written in the standard, we assume all returns of a 'edge of flightline' pulse get the flag.

Can anyone agree on that?

I would appreciate your comment on this.

Thanks
Christian

DI Christian Sevcik
Manager| Strategic Software Alliances

RIEGL Laser Measurement Systems GmbH
Riedenburgstrasse 48, 3580 Horn, Austria
Phone: [+43-2982-4211](tel:+43-2982-4211)
Fax: [+43-2982-4210](tel:+43-2982-4210)
e-mail: csevcik@riegl.com
www: <http://www.riegl.com>

Lewis Graham <lgraham@geocue.com>

Tue, Mar 29, 2016 at 5:04 AM

To: Christian Sevcik <csevcik@riegl.com>, Evon Silvia <esilvia@quantumspatial.com>

Cc: "Heidemann, Hans" <kheidemann@usgs.gov>, Michael Rosen <mrosen@lizardtech.com>, "sdharmapuri@mbakercorp.com" <sdharmapuri@mbakercorp.com>, Wanning Peng <wpeng@esri.com>, Arttu Soininen <arttu.soininen@kolumbus.fi>, Christopher Parrish <Christopher.Parrish@oregonstate.edu>, David Reid <david.reid@optech.com>, Derek Morris <dmorris@geocue.com>, Gerhard Loeffler <Gerhard_Loeffler@trimble.com>, Howard Butler <hobu.inc@gmail.com>, "Martin Isenburg (martin.isenburg@gmail.com)" <martin.isenburg@gmail.com>, Mike Umansky <mumansky@appliedimagery.com>, Paul Galla <paul.galla@leicaus.com>

Two points (ha, another pun) I would make:

- If we retain edge of scan (it sounds as if there is consensus that we should) than all returns associated with the edge of scan outbound pulse should be flagged.
- It is a misconception that the Edge of Scan flagged pulses represent the true edge of a flight line in object space. It depends on the pitch, yaw, roll of the sensor at the time of the pulse as well as the terrain. It was never intended to mean the edge of light line in object (ground) space.

Best Regards,

Lewis

Lewis Graham

GeoCue Group

9668 Madison Blvd., Suite 202

Madison, AL USA 35758

01-256-461-8289

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From: Christian Sevcik [mailto:csevcik@riegl.com]

Sent: Tuesday, March 29, 2016 06:55

To: Evon Silvia <esilvia@quantumspatial.com>; Lewis Graham <lgraham@geocue.com>

Cc: Heidemann, Hans <kheidemann@usgs.gov>; Michael Rosen <mrosen@lizardtech.com>;
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<mumansky@appliedimagery.com>; Paul Galla <paul.galla@leicaus.com>

Subject: AW: US - Las Working Group - Edge of Flightline flag

Thank you all for sharing the insights.

From what was discussed here, we found it is best to flag single and last returns on the left and right edge of the swath.

Christian

DI Christian Sevcik

Manager | Strategic Software Alliances



RIEGL Laser Measurement Systems GmbH

Riedenburgstrasse 48, 3580 Horn, Austria

Phone: +43-2982-4211

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e-mail: csevcik@riegl.comwww: <http://www.riegl.com>**Von:** Evon Silvia [<mailto:esilvia@quantumspatial.com>]**Gesendet:** Mittwoch, 23. März 2016 16:41**An:** Lewis Graham**Cc:** Christian Sevcik; Heidemann, Hans; Michael Rosen; sdharmapuri@mbakercorp.com; Wanning Peng; Arttu Soinen; Christopher Parrish; David Reid; Derek Morris; Gerhard Loeffler; Howard Butler; Martin Isenburg (martin.isenburg@gmail.com); Mike Umansky; Paul Galla**Betreff:** Re: US - Las Working Group - Edge of Flightline flag

Thanks for the background, Lewis. One thing to note is that our experience is that the issue of poor geometry at the swath edges is still a very real and present problem in high resolution and high accuracy LiDAR, both for the oscillating mirror and rotating prism scanners. You are correct, though, that newer scanners have reduced this error significantly over previous generations. My theory is that the error we are observing has everything to do with the obliqueness as you get further off-nadir, rather than the mechanical properties of the scanner itself like with previous generations.

Still, my point is that this isn't just a problem left in the history books and remains relevant with current technology. In fact, I've spent the past 3 days improving our edge filtering algorithms...

Evon

--

Evon Silvia PLS
Geomatics Specialist
517 SW 2nd Street, Suite 400, Corvallis, OR 97333
P: (541) 452-8502

E: esilvia@quantumspatial.com

On Wed, Mar 23, 2016 at 5:29 AM, Lewis Graham <lgraham@geocue.com> wrote:

Just a bit (pun intended) of history –

When we did the very first LAS (prior to it being turned over to the ASPRS), the “edge of swath” bit was intended to allow a user to trim “bad” data.

As you probably recall, the oscillating scanners used to be unreliable from the perspective of position encoding during mirror reversal.

The idea was that one could detect the edge of scan pulse, look up the GPS time stamp and then remove points near this point with near meaning from the time perspective (you could not do it from position due to the encoder issues).

There were all sorts of “best practice” approaches such as to routinely clip x% at the edge of swath and so forth.

Of course, the correct answer was that the manufacture should remove known bad data prior to the first encoding and that, I think, is where things went.

So the edge of scan is an old artifact of a bad practice we were all engaged in back in the early days when the sensors were still really somewhat experimental.

Perhaps we could simply redefine this as “edge of swath” and use it for generating coverage polygons. If it gets clipped out in a thinning/clipping process, then we should not worry about it.

An alternative is to simply deprecate it entirely.

Regards,

Lewis

Lewis Graham

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This makes sense?

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DI Christian Sevcik

Manager | Strategic Software Alliances



RIEGL Laser Measurement Systems GmbH

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Phone: +43-2982-4211

Fax: +43-2982-4210

e-mail: csevcik@riegl.com

www: <http://www.riegl.com>

Von: Heidemann, Hans [<mailto:kheidemann@usgs.gov>]

Gesendet: Mittwoch, 16. März 2016 17:03

An: Christian Sevcik

Cc: Evon Silvia; Lewis Graham; Michael Rosen; sdharmapuri@mbakercorp.com; Wanning Peng; Arttu Soinenen; Christopher Parrish; David Reid; Derek Morris; Gerhard Loeffler; Howard Butler; Martin Isenburg (martin.isenburg@gmail.com); Mike Umansky; Paul Galla

Betreff: Re: US - Las Working Group - Edge of Flightline flag

Thank you Evon.

Christian,

We (the industry) struggled with points in separate files for too many years. I for one do not want to go back and I have worked mighty hard over my career to help develop LAS and ensure that software has been developed such that maximum advantage of point cloud data can be leveraged.

You mention that potentially "... filtering, cleaning, maybe thinning, clipping, merging,... is happening to the data before it is written to a LAS for the first time."

I find this troubling as it imposes irreversible limitations on the data to the end user - the people who are paying for the data. I won't argue that many, many end users may truly only want derivative products, but others want and need the entire "raw" point cloud for their work. Without it, the industry and entire geospatial community is locked into the black-box derivative products that vendors provide, and further research into the wealth of information that point clouds hold is hobbled.

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Karl

_____ **H. Karl Heidemann, GISP, CMS**

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Sioux Falls, SD 57198

[605-594-2861](tel:605-594-2861)

kheidemann@usgs.gov

"Nothing matters very much, and very few things ... matter at all."

- Arthur James Balfour

On Wed, Mar 16, 2016 at 3:41 AM, Christian Sevcik <csevcik@riegl.com> wrote:

Evon,

Thanks a lot for your reply. It is a bit of an eye opener, as it seems we are looking at the same topic from different angles.

Our workflow is somewhere between the scanner and the LAS file, therefore some processing in terms of filtering, cleaning, maybe thinning, clipping, merging,... is happening to the data before it is written to a LAS for the first time. In my understanding the characteristics, which qualify a point as edge of flight line are set during acquisition and due to some of processing steps mentioned above, probably not survive until the LAS file is written.

The discussion with you guys shed some light on the topic and I will definitely share this with our developers.

Thank you!

Christian

DI Christian Sevcik

Manager | Strategic Software Alliances



RIEGL Laser Measurement Systems GmbH

Riedenburgstrasse 48, 3580 Horn, Austria

Phone: +43-2982-4211

Fax: +43-2982-4210

e-mail: csevcik@riegl.com

www: <http://www.riegl.com>

Von: Evon Silvia [<mailto:esilvia@quantumspatial.com>]

Gesendet: Dienstag, 15. März 2016 17:41

An: Christian Sevcik

Cc: Heidemann, Hans; Lewis Graham; Michael Rosen; sdharmapuri@mbakercorp.com; Wanning Peng; Arttu Soinenen; Christopher Parrish; David Reid; Derek Morris; Gerhard Loeffler; Howard Butler; Martin Isenburg (martin.isenburg@gmail.com); Mike Umansky; Paul Galla

Betreff: Re: US - Las Working Group - Edge of Flightline flag

Christian,

I would think that it depends on which data you're talking about. Generally, for filtering in post-processing software like LAStools, TerraSolid, GeoCue, LP360, RiProcess, etc, I wouldn't expect those software packages to re-apply the edge flag unless they're running a routine designed for that purpose. That would be a nearly impossible expectation to meet, especially on tiled data.

The discussion gets more interesting for the software producing/extracting swaths from the raw sensor data – in your case, RiAnalyze probably. In that case, the software should be producing edge flags on every line because the user would reasonably expect valid data straight from the sensor. Consider this example, arbitrary swath:



If I extract every point, I would expect RiAnalyze to correctly apply edge flags to the orange points on the ends of every line.

But what if a filter is being applied in the extraction software, though? For example, a 2° edge clip would remove the orange and green points, leaving just the black and red. Should the red be flagged as edge? Well... I waffled back and forth about 8 times while writing this email so I honestly don't know. I wouldn't *expect* the edge flags, but they would still be useful in both cases for all the same reasons that they were useful in the first place. I can't think of a reason *not* to flag them, except in the unusual circumstance where you want to merge clipped and unclipped data... which I've had to do a several times recently. Maybe make it optional?

For another example, if I only extracted every 5th pulse for faster quicklooking, the original right-hand edge point would be lost.



Should the red point be flagged as an edge? I'm not sure, but probably not in this case. Final data is very rarely produced in this way as far as I know. For the example that you proposed of filtering based on return, I probably wouldn't expect edge flags.

This is very similar to the question of what should be done after running an atmospheric noise filter. If I have 5 returns and I filter out the first 2, should I renumber the returns so that they are "x of 3" instead of "x of 5"? Most people don't, even though there are now only 3 points in the pulse. **If you never actually remove the data and only classify it like Karl insists, this entire discussion is completely moot.** In my opinion, questions like these are the best reason to deliver all data and use Withheld flags. (Tangent: If manufacturers added an option to FLAG clipped points as Withheld instead of removing it, that would make the lives of data vendors immensely easier, as Karl's preference is a requirement for all 3DEP contracts.)

In the end, I think my answer is that users would expect edge flags on both ends of every line unless a filter is applied. For filtered data, it's up to the user to add edge flags. The notable exception for me is when applying an edge clip, in which case I would leave it up to the user.

The others on this list are invited to disagree. :)

Evon

--

Evon Silvia PLS
Geomatics Specialist
517 SW 2nd Street, Suite 400, Corvallis, OR 97333
P: (541) 452-8502

E: esilvia@quantumspatial.com

On Tue, Mar 15, 2016 at 1:33 AM, Christian Sevcik <csevcik@riegl.com> wrote:

Karl,

Evon,

Thanks for the input. This sounds good to me.

I get your arguments of either flagging single and first or single and last returns, or alternating at the beginning and end of a scanline.

Would you expect flagged points at every single scan line?

I am thinking of datasets filtered for certain purpose, for instance single and last returns for DTM creation, or single and first for DSM. In this case some of the flagged points won't make it to the LAS file. So you end up with some lines fully flagged, some partially and maybe some not flagged at all. Very likely there are still enough points to calculate for a fairly good boundary, but it is definitely not a perfect fit. Any concerns here?

Thanks

Christian

DI Christian Sevcik

Manager | Strategic Software Alliances



RIEGL Laser Measurement Systems GmbH

Riedenburgstrasse 48, 3580 Horn, Austria

Phone: +43-2982-4211

Fax: +43-2982-4210

e-mail: csevcik@riegl.comwww: <http://www.riegl.com>**Von:** Heidemann, Hans [mailto:kheidemann@usgs.gov]**Gesendet:** Montag, 14. März 2016 19:16**An:** Evon Silvia**Cc:** Christian Sevcik; Lewis Graham; Michael Rosen; sdharnapuri@mbakercorp.com; Wanning Peng; Arttu Soininen; Christopher Parrish; David Reid; Derek Morris; Gerhard Loeffler; Howard Butler; Martin Isenburg (martin.isenburg@gmail.com); Mike Umansky; Paul Galla**Betreff:** Re: US - Las Working Group - Edge of Flightline flag

and using the Withheld Flag for the outer points still retains the edge points so, even though they would be also flagged as withheld, you are not prevented from building those polygons.

Karl

H. Karl Heidemann, GISP, CMS*Physical Scientist, Lidar Science*

U.S. Geological Survey

Mundt Federal Building

47914 252nd Street

Sioux Falls, SD 57198

605-594-2861

kheidemann@usgs.gov

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On Mon, Mar 14, 2016 at 12:57 PM, Evon Silvia <esilvia@quantumspatial.com> wrote:

Good point on the value on simply having a point on either edge of the swath. Coverage polygons would be so much easier if the edge flag was properly encoded all the time and no points were ever deleted.

Evon

On Mon, Mar 14, 2016 at 9:14 AM, Heidemann, Hans <kheidemann@usgs.gov> wrote:

lol

And I would not disagree with Evon on his point about the Last Return over First return. In most all cases, it really doesn't matter all that much. Evon knows considerably more than I do about internal coding nuances.

I would disagree on the point of the edge flag. In my mind, the point is, as Christian initially asserted, to more easily identify a precise edge of the swath data. My biggest concern is, perhaps, a semantic one: Evon stated that it allows a simpler means to "clip" the edges. The term "clip" is too often understood to mean "remove" -- this approach is wholly unacceptable. If the outer extremes of a swath need to be "removed" (as the term "clip" would imply), that should be handled by flagging those points with the Withheld Flag. That is what the Withheld Flag has always been intended to signify. Why it has been so widely ignored (pun intended) is a topic for a completely different rant. ;-)

Thanks Evon!
See you in Ft. Worth?

Karl

H. Karl Heidemann, GISP, CMS

Physical Scientist, Lidar Science

U.S. Geological Survey

Mundt Federal Building

47914 252nd Street

Sioux Falls, SD 57198

[605-594-2861](tel:605-594-2861)

kheidemann@usgs.gov

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On Mon, Mar 14, 2016 at 11:01 AM, Evon Silvia <esilvia@quantumspatial.com> wrote:

Hello Christian,

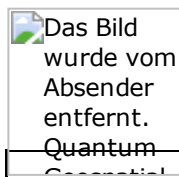
I agree with Karl on all points, except a minor point for Question 3: I would suggest flagging the LAST return for the final pulse to hit a particular face and the FIRST return of the first pulse to hit a face. Most sorting algorithms would sort points in that manner (chronologically by timestamp, then by return), so that would ensure adjacency.

The point of the edge flag is to give users the ability to conveniently "clip" the edges of a flightline for whatever reason they deem worthy. Two examples off the top of my head include geometric distortion at flightline edges and clipping/flagging/filtering overlap areas for setting the Overlap bit. This procedure is significantly simplified by the addition of a Edge Flag.

Great question! Definitely a point that can be clarified in the spec. I don't believe there was any intent to change the definition of the Edge Flag between the point formats.

Evon

--



Evon Silvia PLS
Geomatics Specialist
517 SW 2nd Street, Suite 400, Corvallis, OR 97333
P: (541) 452-8502
E: esilvia@quantumspatial.com

On Mon, Mar 14, 2016 at 8:54 AM, Heidemann, Hans <kheidemann@usgs.gov> wrote:

H Christian,

This is only my opinion and may not represent even a plurality of the committee.

Question 1: It seems to me that, if you can flag the last point of a rotating polygon scanline, it should not be overly difficult to flag the next point, which would be the first point of the next scanline ? Perhaps not; I don't claim to know the internal intricacies of your system processing.

Question 2: I would think that the split between forward and reverse arcs would/should provide a very close approximation of the edges of the swath. Obviously, variations in flight attitude will prevent this from being an absolutely exact boundary, but the same limitation exists for all systems.

Question 3: I would suggest flagging the First Return. Yes, on the outbound scan, there may likely be additional points beyond the First, but the opposite will happen on the inbound scan as well, so it's a pick your poison kind of question. The difference is not likely to be significant either way, flagging the First seems like it would be simpler. Flagging all returns of the pulse is likely to cause further complexity in downstream processing for MOST processes; the additional effort should be placed on the fewer activities that would benefit from that scheme.

Karl

H. Karl Heidemann, GISP, CMS

Physical Scientist, Lidar Science

U.S. Geological Survey

Mundt Federal Building

47914 252nd Street

Sioux Falls, SD 57198

605-594-2861

kheidemann@usgs.gov

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On Mon, Mar 14, 2016 at 9:29 AM, Christian Sevcik <csevcik@riegl.com> wrote:

Hello LWG,

We received a request to populate the edge of flight line flag.

According to the standard - I refer to las specification version 1.4 r13, July 2013- the flag is defined as:

For point data records 0-5

"Edge of Flight Line: The Edge of Flight Line data bit has a value of 1 only when the point is at the end of a scan. It is the last point on a given scan line before it changes direction."

For point data records 6-10

"Edge of Flight Line: The Edge of Flight Line data bit has a value of 1 only when the point is at the end of a scan. It is the last point on a given scan line before it changes direction or the mirror facet changes. Note that this field has no meaning for 360° Field of View scanners (such as Mobile LIDAR scanners) and should not be set."

This brings up 3 questions and I wonder, if there is consent within the group ;-)

Definition 1 can only apply to oscillating mirror scanners, as there is no change in direction for a rotating polygon wheel mirror scanners.

This also means that there is no edge of flightline flag in LAS files version 1.1 -1.3 for polygon wheel scanners.

Definition 2 explicitly addresses facet change and therefore allows to set this flag for polygon wheel scanners for LAS 1.4 and point data record format 6 -10.

As it is stated, only the last point before a facet change can be flagged as edge of flight line, 'edge points' are created on one side of the flight line only. As I understand the intention of the flag is to quickly calculate for the ground coverage of a flightline, but we seem to get stuck here.

Question 2 is about circular scan patterns. There is neither a change in direction, nor a change of facet. For computational reasons we split a circle into a forward arc and a backward arc. Would it be safe to introduce such artificial edges?

The third question is about the returns to be flagged. Although it is not written in the standard, we assume all returns of a 'edge of flightline' pulse get the flag.

Can anyone agree on that?

I would appreciate your comment on this.

Thanks
Christian

DI Christian Sevcik
Manager| Strategic Software Alliances

RIEGL Laser Measurement Systems GmbH
Riedenburgstrasse 48, 3580 Horn, Austria
Phone: [+43-2982-4211](tel:+43-2982-4211)
Fax: [+43-2982-4210](tel:+43-2982-4210)
e-mail: csevcik@riegl.com
www: <http://www.riegl.com>

Christian Sevcik <csevcik@riegl.com>

Tue, Mar 29, 2016 at 9:33 AM

To: Lewis Graham <lgraham@geocue.com>, Evon Silvia <esilvia@quantumspatial.com>

Cc: "Heidemann, Hans" <kheidemann@usgs.gov>, Michael Rosen <mrosen@lizardtech.com>, "sdharmapuri@mbakercorp.com" <sdharmapuri@mbakercorp.com>, Wanning Peng <wpeng@esri.com>, Arttu Soininen <arttu.soininen@kolumbus.fi>, Christopher Parrish <Christopher.Parrish@oregonstate.edu>, David Reid <david.reid@optech.com>, Derek Morris <dmorris@geocue.com>, Gerhard Loeffler <Gerhard_Loeffler@trimble.com>, Howard Butler <hobu.inc@gmail.com>, "Martin Isenburg (martin.isenburg@gmail.com)" <martin.isenburg@gmail.com>, Mike Umansky <mumansky@appliedimagery.com>, Paul Galla <paul.galla@leicaus.com>

Thanks Lewis, it seems our little plan just run aground.. ;-)

So you are saying all returns should be flagged?

I understand there are valid arguments on both sides, flag all and flag single/first/last only.

Technically both can be done, but what is closest to the specification?

Christian

DI Christian Sevcik

Manager | Strategic Software Alliances



RIEGL Laser Measurement Systems GmbH

Riedenburgstrasse 48, 3580 Horn, Austria

Phone: +43-2982-4211

Fax: +43-2982-4210

e-mail: csevcik@riegl.com

www: <http://www.riegl.com>

Von: Lewis Graham [<mailto:lgraham@geocue.com>]

Gesendet: Dienstag, 29. März 2016 14:05

An: Christian Sevcik; Evon Silvia

Cc: Heidemann, Hans; Michael Rosen; sdharmapuri@mbakercorp.com; Wanning Peng; Arttu Soinen; Christopher Parrish; David Reid; Derek Morris; Gerhard Loeffler; Howard Butler; Martin Isenburg (martin.isenburg@gmail.com); Mike Umansky; Paul Galla

Betreff: RE: US - Las Working Group - Edge of Flightline flag

Two points (ha, another pun) I would make:

- If we retain edge of scan (it sounds as if there is consensus that we should) than all returns associated with the edge of scan outbound pulse should be flagged.
- It is a misconception that the Edge of Scan flagged pulses represent the true edge of a flight line in object space. It depends on the pitch, yaw, roll of the sensor at the time of the pulse as well as the terrain. It was never intended to mean the edge of light line in object (ground) space.

Best Regards,

Lewis

Lewis Graham

GeoCue Group

9668 Madison Blvd., Suite 202

Madison, AL USA 35758

01-256-461-8289

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From: Christian Sevcik [<mailto:csevcik@riegl.com>]

Sent: Tuesday, March 29, 2016 06:55

To: Evon Silvia <esilvia@quantumspatial.com>; Lewis Graham <lgraham@geocue.com>

Cc: Heidemann, Hans <kheidemann@usgs.gov>; Michael Rosen <mrosen@lizardtech.com>;
sdharmapuri@mbakercorp.com; Wanning Peng <wpeng@esri.com>; Arttu Soinen
<arttu.soininen@kolumbus.fi>; Christopher Parrish <Christopher.Parrish@oregonstate.edu>; David Reid
<david.reid@optech.com>; Derek Morris <dmorris@geocue.com>; Gerhard Loeffler
<Gerhard_Loeffler@trimble.com>; Howard Butler <hobu.inc@gmail.com>; Martin Isenburg
(martin.isenburg@gmail.com) <martin.isenburg@gmail.com>; Mike Umansky
<mumansky@appliedimagery.com>; Paul Galla <paul.galla@leicaus.com>

Subject: AW: US - Las Working Group - Edge of Flightline flag

Thank you all for sharing the insights.

From what was discussed here, we found it is best to flag single and last returns on the left and right edge of the swath.

Christian

DI Christian Sevcik

Manager | Strategic Software Alliances



RIEGL Laser Measurement Systems GmbH

Riedenburgstrasse 48, 3580 Horn, Austria

Phone: +43-2982-4211

Fax: +43-2982-4210

e-mail: csevcik@riegl.com

www: <http://www.riegl.com>

Von: Evon Silvia [<mailto:esilvia@quantumspatial.com>]

Gesendet: Mittwoch, 23. März 2016 16:41

An: Lewis Graham

Cc: Christian Sevcik; Heidemann, Hans; Michael Rosen; sdharmapuri@mbakercorp.com; Wanning Peng; Arttu Soinenen; Christopher Parrish; David Reid; Derek Morris; Gerhard Loeffler; Howard Butler; Martin Isenburg (martin.isenburg@gmail.com); Mike Umansky; Paul Galla

Betreff: Re: US - Las Working Group - Edge of Flightline flag

Thanks for the background, Lewis. One thing to note is that our experience is that the issue of poor geometry at the swath edges is still a very real and present problem in high resolution and high accuracy LiDAR, both for the oscillating mirror and rotating prism scanners. You are correct, though, that newer scanners have reduced this error significantly over previous generations. My theory is that the error we are observing has everything to do with the obliqueness as you get further off-nadir, rather than the mechanical properties of the scanner itself like with previous generations.

Still, my point is that this isn't just a problem left in the history books and remains relevant with current technology. In fact, I've spent the past 3 days improving our edge filtering algorithms...

Evon

--

Evon Silvia PLS
Geomatics Specialist
517 SW 2nd Street, Suite 400, Corvallis, OR 97333
P: (541) 452-8502

E: esilvia@quantumspatial.com

On Wed, Mar 23, 2016 at 5:29 AM, Lewis Graham <lgraham@geocue.com> wrote:

Just a bit (pun intended) of history –

When we did the very first LAS (prior to it being turned over to the ASPRS), the “edge of swath” bit was intended to allow a user to trim “bad” data.

As you probably recall, the oscillating scanners used to be unreliable from the perspective of position encoding during mirror reversal.

The idea was that one could detect the edge of scan pulse, look up the GPS time stamp and then remove points near this point with near meaning from the time perspective (you could not do it from position due to the encoder issues).

There were all sorts of “best practice” approaches such as to routinely clip x% at the edge of swath and so forth.

Of course, the correct answer was that the manufacture should remove known bad data prior to the first encoding and that, I think, is where things went.

So the edge of scan is an old artifact of a bad practice we were all engaged in back in the early days when the sensors were still really somewhat experimental.

Perhaps we could simply redefine this as “edge of swath” and use it for generating coverage polygons. If it gets clipped out in a thinning/clipping process, then we should not worry about it.

An alternative is to simply deprecate it entirely.

Regards,

Lewis

Lewis Graham

GeoCue Group

9668 Madison Blvd., Suite 202

Madison, AL USA 35758

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From: Christian Sevcik [mailto:csevcik@riegl.com]

Sent: Wednesday, March 16, 2016 11:40

To: Heidemann, Hans <kheidemann@usgs.gov>

Cc: Evon Silvia <esilvia@quantumspatial.com>; Lewis Graham <lgraham@geocue.com>; Michael Rosen <mrosen@lizardtech.com>; sdharmapuri@mbakercorp.com; Wanning Peng <wpeng@esri.com>; Arttu Soinen <arttu.soininen@kolumbus.fi>; Christopher Parrish <Christopher.Parrish@oregonstate.edu>; David Reid <david.reid@optech.com>; Derek Morris <dmorris@geocue.com>; Gerhard Loeffler <Gerhard_Loeffler@trimble.com>; Howard Butler <hobu.inc@gmail.com>; Martin Isenburg (martin.isenburg@gmail.com) <martin.isenburg@gmail.com>; Mike Umansky <mumansky@appliedimagery.com>; Paul Galla <paul.galla@leicaus.com>

Subject: AW: US - Las Working Group - Edge of Flightline flag

Karl,

I get your point and I probably did not make myself clear enough. The software processes the data with parameters controlled by the user. If a full unfiltered,... all the things you put in blue below.. is required, it can be done. It is not a black box, out of control processing engine. So, if you order the data from your service provider with no processing applied, it is perfectly possible.

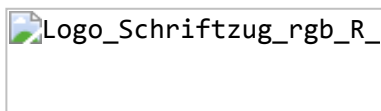
But I know people are using the software to further process the data and create some kind of deliverables. And this includes thinning, clipping, merging,..., so we have to provide these functions. But again, it is the user who controls the amount of processing applied to the data.

This makes sense?

Christian

DI Christian Sevcik

Manager | Strategic Software Alliances



RIEGL Laser Measurement Systems GmbH

Riedenburgstrasse 48, 3580 Horn, Austria

Phone: +43-2982-4211

Fax: +43-2982-4210

e-mail: csevcik@riegl.com

www: <http://www.riegl.com>

Von: Heidemann, Hans [<mailto:kheidemann@usgs.gov>]

Gesendet: Mittwoch, 16. März 2016 17:03

An: Christian Sevcik

Cc: Evon Silvia; Lewis Graham; Michael Rosen; sdharnapuri@mbakercorp.com; Wanning Peng; Arttu Soininen; Christopher Parrish; David Reid; Derek Morris; Gerhard Loeffler; Howard Butler; Martin Isenburg (martin.isenburg@gmail.com); Mike Umansky; Paul Galla

Betreff: Re: US - Las Working Group - Edge of Flightline flag

Thank you Evon.

Christian,

We (the industry) struggled with points in separate files for too many years. I for one do not want to go back and I have worked mighty hard over my career to help develop LAS and ensure that software has been developed such that maximum advantage of point cloud data can be leveraged.

You mention that potentially "... filtering, cleaning, maybe thinning, clipping, merging,... is happening to the data before it is written to a LAS for the first time."

I find this troubling as it imposes irreversible limitations on the data to the end user - the people who are paying for the data. I won't argue that many, many end users may truly only want derivative products, but others want and need the entire "raw" point cloud for their work. Without it, the industry and entire geospatial community is locked into the black-box derivative products that vendors provide, and further research into the wealth of information that point clouds hold is hobbled.

As we stress in our Lidar Base Specification, the USGS regards the full and complete point cloud as the primary data deliverable for a lidar collection. We are paying for a collection; we want the data that has been collected. DEMs, DSMs, Intensity Images -- these are derivative products.

It is my view, overly simplified and perhaps narrowly perceived, that as swaths of point data come out of manufacturers' pre-processing software, proper geometric corrections should have been applied, edge flags assigned, and geometrically unreliable points (those clearly blunderous points outside the rational 3D extents of the swath - either horizontally or vertically, and near-edge points) will have been flagged as Withheld. Minor geometric

corrections *to swaths* may be applied to the outputted LAS point cloud files. I *personally* do not favor methods that apply geometric corrections after swaths have been combined and tiled. That said, I fully realize that different data producers use different techniques, and I accept and allow that the proof has to be in the delivered data. But regardless of how good that data is, we here have a responsibility to know more about it's lineage -- kinda like knowing your fancy restaurant dinner has no allergens or GMOs in it. Doesn't mean you won't eat it, but you have to know. This is why we require delivery of full, complete swaths -- in their final geometry -- as a principle deliverable.

As most of the recipients here are aware, I am still on my overarching, seemingly life-long crusade to move the industry past the entire tiling debacle with the development of full end-to-end swath-based lidar production, processing, and exploitation software. We are all wasting mountains of time and money on tiles. Obviously, the requirements and "standards" we have established thus far are critical foundation pieces for that goal.

Karl

 **H. Karl Heidemann, GISP, CMS**

Physical Scientist, Lidar Science

U.S. Geological Survey

Mundt Federal Building

47914 252nd Street

Sioux Falls, SD 57198

[605-594-2861](tel:605-594-2861)

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On Wed, Mar 16, 2016 at 3:41 AM, Christian Sevcik <csevcik@riegl.com> wrote:

Evon,

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Our workflow is somewhere between the scanner and the LAS file, therefore some processing in terms of filtering, cleaning, maybe thinning, clipping, merging,... is happening to the data before it is written to a LAS for the first time. In my understanding the characteristics, which qualify a point as edge of flight line are set during acquisition and due to some of processing steps mentioned above, probably not survive until the LAS file is written.

The discussion with you guys shed some light on the topic and I will definitely share this with our developers.

Thank you!

Christian

DI Christian Sevcik

Manager | Strategic Software Alliances



RIEGL Laser Measurement Systems GmbH

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Phone: +43-2982-4211

Fax: +43-2982-4210

e-mail: csevcik@riegl.com

www: <http://www.riegl.com>

Von: Evon Silvia [<mailto:esilvia@quantumspatial.com>]

Gesendet: Dienstag, 15. März 2016 17:41

An: Christian Sevcik

Cc: Heidemann, Hans; Lewis Graham; Michael Rosen; sdharmapuri@mbakercorp.com; Wanning Peng; Arttu Soinenin; Christopher Parrish; David Reid; Derek Morris; Gerhard Loeffler; Howard Butler; Martin Isenburg (martin.isenburg@gmail.com); Mike Umansky; Paul Galla

Betreff: Re: US - Las Working Group - Edge of Flightline flag

Christian,

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But what if a filter is being applied in the extraction software, though? For example, a 2° edge clip would remove the orange and green points, leaving just the black and red. Should the red be flagged as edge? Well... I waffled back and forth about 8 times while writing this email so I honestly don't know. I wouldn't *expect* the edge flags, but they would still be useful in both cases for all the same reasons that they were useful in the first place. I can't think of a reason *not* to flag them, except in the unusual circumstance where you want to merge clipped and unclipped data... which I've had to do a several times recently. Maybe make it optional?

For another example, if I only extracted every 5th pulse for faster quicklooking, the original right-hand edge point would be lost.



Should the red point be flagged as an edge? I'm not sure, but probably not in this case. Final data is very rarely produced in this way as far as I know. For the example that you proposed of filtering based on return, I probably wouldn't expect edge flags.

This is very similar to the question of what should be done after running an atmospheric noise filter. If I have 5 returns and I filter out the first 2, should I renumber the returns so that they are "x of 3" instead of "x of 5"? Most people don't, even though there are now only 3 points in the pulse. **If you never actually remove the data and only classify it like Karl insists, this entire discussion is completely moot.** In my opinion, questions like these are the best reason to deliver all data and use Withheld flags. (Tangent: If manufacturers added an option to FLAG clipped points as Withheld instead of removing it, that would make the lives of data vendors immensely easier, as Karl's preference is a requirement for all 3DEP contracts.)

In the end, I think my answer is that users would expect edge flags on both ends of every line unless a filter is applied. For filtered data, it's up to the user to add edge flags. The notable exception for me is when applying an edge clip, in

which case I would leave it up to the user.

The others on this list are invited to disagree. :)

Evon

--

Evon Silvia PLS
Geomatics Specialist
517 SW 2nd Street, Suite 400, Corvallis, OR 97333
P: (541) 452-8502

E: esilvia@quantumspatial.com

On Tue, Mar 15, 2016 at 1:33 AM, Christian Sevcik <csevcik@riegl.com> wrote:

Karl,

Evon,

Thanks for the input. This sounds good to me.

I get your arguments of either flagging single and first or single and last returns, or alternating at the beginning and end of a scanline.

Would you expect flagged points at every single scan line?

I am thinking of datasets filtered for certain purpose, for instance single and last returns for DTM creation, or single and first for DSM. In this case some of the flagged points won't make it to the LAS file. So you end up with some lines fully flagged, some partially and maybe some not flagged at all. Very likely there are still enough points to calculate for a fairly good boundary, but it is definitely not a perfect fit. Any concerns here?

Thanks

Christian

DI Christian Sevcik

Manager | Strategic Software Alliances



RIEGL Laser Measurement Systems GmbH

Riedenburgstrasse 48, 3580 Horn, Austria

Phone: +43-2982-4211

Fax: +43-2982-4210

e-mail: csevcik@riegl.comwww: <http://www.riegl.com>**Von:** Heidemann, Hans [mailto:kheidemann@usgs.gov]**Gesendet:** Montag, 14. März 2016 19:16**An:** Evon Silvia**Cc:** Christian Sevcik; Lewis Graham; Michael Rosen; sdharmapuri@mbakercorp.com; Wanning Peng; Arttu Soininen; Christopher Parrish; David Reid; Derek Morris; Gerhard Loeffler; Howard Butler; Martin Isenburg (martin.isenburg@gmail.com); Mike Umansky; Paul Galla**Betreff:** Re: US - Las Working Group - Edge of Flightline flag

and using the Withheld Flag for the outer points still retains the edge points so, even though they would be also flagged as withheld, you are not prevented from building those polygons.

Karl

 **H. Karl Heidemann, GISP, CMS***Physical Scientist, Lidar Science*

U.S. Geological Survey

Mundt Federal Building

47914 252nd Street

Sioux Falls, SD 57198

[605-594-2861](tel:605-594-2861)

kheidemann@usgs.gov

"Nothing matters very much, and very few things ... matter at all."

- Arthur James Balfour

On Mon, Mar 14, 2016 at 12:57 PM, Evon Silvia <esilvia@quantumspatial.com> wrote:

Good point on the value on simply having a point on either edge of the swath. Coverage polygons would be so much easier if the edge flag was properly encoded all the time and no points were ever deleted.

Evon

On Mon, Mar 14, 2016 at 9:14 AM, Heidemann, Hans <kheidemann@usgs.gov> wrote:

lol

And I would not disagree with Evon on his point about the Last Return over First return. In most all cases, it really doesn't matter all that much. Evon knows considerably more than I do about internal coding nuances.

I would disagree on the point of the edge flag. In my mind, the point is, as Christian initially asserted, to more easily identify a precise edge of the swath data. My biggest concern is, perhaps, a semantic one: Evon stated that it allows a simpler means to "clip" the edges. The term "clip" is too often understood to mean "remove" -- this approach is wholly unacceptable. If the outer extremes of a swath need to be "removed" (as the term "clip" would imply), that should be handled by flagging those points with the Withheld Flag. That is what the Withheld Flag has always been intended to signify. Why it has been so widely ignored (pun intended) is a topic for a completely different rant. ;-)

Thanks Evon!
See you in Ft. Worth?

Karl

 **H. Karl Heidemann, GISP, CMS**

Physical Scientist, Lidar Science

3/20/2017

Quantum Spatial Mail - US - Las Working Group - Edge of Flightline flag

U.S. Geological Survey
Mundt Federal Building
47914 252nd Street
Sioux Falls, SD 57198
[605-594-2861](tel:605-594-2861)
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On Mon, Mar 14, 2016 at 11:01 AM, Evon Silvia <esilvia@quantumspatial.com> wrote:

Hello Christian,

I agree with Karl on all points, except a minor point for Question 3: I would suggest flagging the LAST return for the final pulse to hit a particular face and the FIRST return of the first pulse to hit a face. Most sorting algorithms would sort points in that manner (chronologically by timestamp, then by return), so that would ensure adjacency.

The point of the edge flag is to give users the ability to conveniently "clip" the edges of a flightline for whatever reason they deem worthy. Two examples off the top of my head include geometric distortion at flightline edges and clipping/flagging/filtering overlap areas for setting the Overlap bit. This procedure is significantly simplified by the addition of a Edge Flag.

Great question! Definitely a point that can be clarified in the spec. I don't believe there was any intent to change the definition of the Edge Flag between the point formats.

Evon

--

Evon Silvia PLS
Geomatics Specialist
517 SW 2nd Street, Suite 400, Corvallis, OR 97333
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This is only my opinion and may not represent even a plurality of the committee.

Question 1: It seems to me that, if you can flag the last point of a rotating polygon scanline, it should not be overly difficult to flag the next point, which would be the first point of the next scanline ? Perhaps not; I don't claim to know the internal intricacies of your system processing.

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Question 3: I would suggest flagging the First Return. Yes, on the outbound scan, there may likely be additional points beyond the First, but the opposite will happen on the inbound scan as well, so it's a pick your poison kind of question. The difference is not likely to be significant either way, flagging the First seems like it would be simpler. Flagging all returns of the pulse is likely to cause further complexity in downstream processing for MOST processes; the additional effort should be placed on the fewer activities that would benefit from that scheme.

Karl

 **H. Karl Heidemann, GISP, CMS**

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We received a request to populate the edge of flight line flag.

According to the standard - I refer to las specification version 1.4 r13, July 2013- the flag is defined as:

For point data records 0-5

"Edge of Flight Line: The Edge of Flight Line data bit has a value of 1 only when the point is at the end of a scan. It is the last point on a given scan line before it changes direction."

For point data records 6-10

"Edge of Flight Line: The Edge of Flight Line data bit has a value of 1 only when the point is at the end of a scan. It is the last point on a given scan line before it changes direction or the mirror facet changes. Note that this field has no meaning for 360° Field of View scanners (such as Mobile LIDAR scanners) and should not be set."

This brings up 3 questions and I wonder, if there is consent within the group ;-)

Definition 1 can only apply to oscillating mirror scanners, as there is no change in direction for a rotating polygon wheel mirror scanners.

This also means that there is no edge of flightline flag in LAS files version 1.1 -1.3 for polygon wheel scanners.

Definition 2 explicitly addresses facet change and therefore allows to set this flag for polygon wheel scanners for LAS 1.4 and point data record format 6 -10.

As it is stated, only the last point before a facet change can be flagged as edge of flight line, 'edge points' are created on one side of the flight line only. As I understand the intention of the flag is to quickly calculate for the ground coverage of a flightline, but we seem to get stuck here.

Question 2 is about circular scan patterns. There is neither a change in direction, nor a change of facet. For computational reasons we split a circle into a forward arc and a backward arc. Would it be safe to introduce such artificial edges?

The third question is about the returns to be flagged. Although it is not written in the standard, we assume all returns of a 'edge of flightline' pulse get the flag.

Can anyone agree on that?

I would appreciate your comment on this.

Thanks
Christian

DI Christian Sevcik
Manager| Strategic Software Alliances

RIEGL Laser Measurement Systems GmbH
Riedenburgstrasse 48, 3580 Horn, Austria
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Fax: [+43-2982-4210](tel:+43-2982-4210)
e-mail: csevcik@riegl.com
www: <http://www.riegl.com>

Evon Silvia <esilvia@quantumspatial.com>

Tue, Mar 29, 2016 at 9:40 AM

To: Christian Sevcik <csevcik@riegl.com>

Cc: Lewis Graham <lgraham@geocue.com>, "Heidemann, Hans" <kheidemann@usgs.gov>, Michael Rosen <mrosen@lizardtech.com>, "sdharmapuri@mbakercorp.com" <sdharmapuri@mbakercorp.com>, Wanning Peng <wpeng@esri.com>, Arttu Soininen <arttu.soininen@kolumbus.fi>, Christopher Parrish <Christopher.Parrish@oregonstate.edu>, David Reid <david.reid@optech.com>, Derek Morris <dmorris@geocue.com>, Gerhard Loeffler <Gerhard_Loeffler@trimble.com>, Howard Butler <hobu.inc@gmail.com>, "Martin Isenburg (martin.isenburg@gmail.com)" <martin.isenburg@gmail.com>, Mike Umansky <mumansky@appliedimagery.com>, Paul Galla <paul.galla@leicaus.com>

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Evon

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DI Christian Sevcik
Manager| Strategic Software Alliances

RIEGL Laser Measurement Systems GmbH
Riedenburgstrasse 48, 3580 Horn, Austria
Phone: +43-2982-4211
Fax: +43-2982-4210

e-mail: csevcik@riegl.com
www: <http://www.riegl.com>

Lewis Graham <lgraham@geocue.com>

Tue, Mar 29, 2016 at 10:26 AM

To: Evon Silvia <esilvia@quantumspatial.com>, Christian Sevcik <csevcik@riegl.com>

Cc: "Heidemann, Hans" <kheidemann@usgs.gov>, Michael Rosen <mrosen@lizardtech.com>, "sdharmapuri@mbakercorp.com" <sdharmapuri@mbakercorp.com>, Wanning Peng <wpeng@esri.com>, Arttu Soininen <arttu.soininen@kolumbus.fi>, Christopher Parrish <Christopher.Parrish@oregonstate.edu>, David Reid <david.reid@optech.com>, Derek Morris <dmorris@geocue.com>, Gerhard Loeffler <Gerhard_Loeffler@trimble.com>, Howard Butler <hobu.inc@gmail.com>, "Martin Isenburg (martin.isenburg@gmail.com)" <martin.isenburg@gmail.com>, Mike Umansky <mumansky@appliedimagery.com>, Paul Galla <paul.galla@leicaus.com>

Again, the edge of flight line cannot be determined until geocoding/geometric correction in object space is complete.

LAS was intended to be "close to the metal" so this information is generally not known at encoding time.

Thus the true original intent of edge of scan was the pulse that was emitted just as the mirror was changing direction or the node changed on a rotating prism. A return from this pulse is not necessarily the edge of a flight line in ground space and thus this bit cannot be used to reliably draw the boundary in object (ground space) – although it will, of course, be very close to the true footprint.

With this in mind, it would be quite strange not to encode all the returns with this bit (if we continue to use the meaning of "edge" in sensor space).

I will be the first to admit that the definition in the LAS specification could stand some clarification. The original specification was not careful about distinguishing between a "pulse" and a "point." We need to clean this up.

We can make this whatever folks want – I am just pointing out the legacy and the fact that we do not generally know which returns of which points are on the edge of a flight line at the time this bit needs to be set.

As the expression goes, I don't have much of a dog in this hunt. We never use this bit in our own code because we seldom find it "correctly" set, if it is set at all.

Best Regards,

Lewis

Lewis Graham

GeoCue Group

9668 Madison Blvd., Suite 202

Madison, AL USA 35758

01-256-461-8289

www.geocue.com

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From: Evon Silvia [mailto:esilvia@quantumspatial.com]

Sent: Tuesday, March 29, 2016 11:40

To: Christian Sevcik <csevcik@riegl.com>

Cc: Lewis Graham <lgraham@geocue.com>; Heidemann, Hans <kheidemann@usgs.gov>; Michael Rosen <mrosen@lizardtech.com>; sdharmapuri@mbakercorp.com; Wanning Peng <wpeng@esri.com>; Arttu Soinen <arttu.soininen@kolumbus.fi>; Christopher Parrish <Christopher.Parrish@oregonstate.edu>; David Reid <david.reid@optech.com>; Derek Morris <dmorris@geocue.com>; Gerhard Loeffler <Gerhard_Loeffler@trimble.com>; Howard Butler <hobu.inc@gmail.com>; Martin Isenburg <martin.isenburg@gmail.com>; Mike Umansky <mumansky@appliedimagery.com>; Paul Galla <paul.galla@leicaus.com>

Subject: Re: US - Las Working Group - Edge of Flightline flag

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Evon

On Tue, Mar 29, 2016 at 9:33 AM, Christian Sevcik <csevcik@riegl.com> wrote:

Thanks Lewis, it seems our little plan just run aground.. ;-)

So you are saying all returns should be flagged?

I understand there are valid arguments on both sides, flag all and flag single/first/last only.

Technically both can be done, but what is closest to the specification?

Christian

DI Christian Sevcik

Manager | Strategic Software Alliances



RIEGL Laser Measurement Systems GmbH

Riedenburgstrasse 48, 3580 Horn, Austria

Phone: +43-2982-4211

Fax: +43-2982-4210

e-mail: csevcik@riegl.com

www: <http://www.riegl.com>

Von: Lewis Graham [<mailto:lgraham@geocue.com>]

Gesendet: Dienstag, 29. März 2016 14:05

An: Christian Sevcik; Evon Silvia

Cc: Heidemann, Hans; Michael Rosen; sdharmapuri@mbakercorp.com; Wanning Peng; Arttu Soinen; Christopher Parrish; David Reid; Derek Morris; Gerhard Loeffler; Howard Butler; Martin Isenburg (martin.isenburg@gmail.com); Mike Umansky; Paul Galla

Betreff: RE: US - Las Working Group - Edge of Flightline flag

Two points (ha, another pun) I would make:

- If we retain edge of scan (it sounds as if there is consensus that we should) than all returns associated with the edge of scan outbound pulse should be flagged.
- It is a misconception that the Edge of Scan flagged pulses represent the true edge of a flight line in object space. It depends on the pitch, yaw, roll of the sensor at the time of the pulse as well as the terrain. It was never intended to mean the edge of light line in object (ground) space.

Best Regards,

Lewis

Lewis Graham

GeoCue Group

9668 Madison Blvd., Suite 202

Madison, AL USA 35758

01-256-461-8289

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From: Christian Sevcik [<mailto:csevcik@riegl.com>]

Sent: Tuesday, March 29, 2016 06:55

To: Evon Silvia <esilvia@quantumspatial.com>; Lewis Graham <lgraham@geocue.com>

Cc: Heidemann, Hans <kheidemann@usgs.gov>; Michael Rosen <mrosen@lizardtech.com>; sdharmapuri@mbakercorp.com; Wanning Peng <wpeng@esri.com>; Arttu Soininen <arttu.soininen@kolumbus.fi>; Christopher Parrish <Christopher.Parrish@oregonstate.edu>; David Reid <david.reid@optech.com>; Derek Morris <dmorris@geocue.com>; Gerhard Loeffler <Gerhard_Loeffler@trimble.com>; Howard Butler <hobu.inc@gmail.com>; Martin Isenburg (martin.isenburg@gmail.com) <martin.isenburg@gmail.com>; Mike Umansky <mumansky@appliedimagery.com>; Paul Galla <paul.galla@leicaus.com>

Subject: AW: US - Las Working Group - Edge of Flightline flag

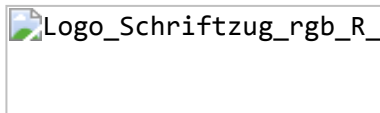
Thank you all for sharing the insights.

From what was discussed here, we found it is best to flag single and last returns on the left and right edge of the swath.

Christian

DI Christian Sevcik

Manager | Strategic Software Alliances



RIEGL Laser Measurement Systems GmbH

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e-mail: csevcik@riegl.com

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Von: Evon Silvia [<mailto:esilvia@quantumspatial.com>]

Gesendet: Mittwoch, 23. März 2016 16:41

An: Lewis Graham

Cc: Christian Sevcik; Heidemann, Hans; Michael Rosen; sdharmapuri@mbakercorp.com; Wanning Peng; Arttu Soininen; Christopher Parrish; David Reid; Derek Morris; Gerhard Loeffler; Howard Butler; Martin Isenburg (martin.isenburg@gmail.com); Mike Umansky; Paul Galla

Betreff: Re: US - Las Working Group - Edge of Flightline flag

Thanks for the background, Lewis. One thing to note is that our experience is that the issue of poor geometry at the swath edges is still a very real and present problem in high resolution and high accuracy LiDAR, both for the oscillating mirror and rotating prism scanners. You are correct, though, that newer scanners have reduced this error significantly over previous generations. My theory is that the error we are observing has everything to do with the obliqueness as you get further off-nadir, rather than the mechanical properties of the scanner itself like with previous generations.

Still, my point is that this isn't just a problem left in the history books and remains relevant with current technology. In fact, I've spent the past 3 days improving our edge filtering algorithms...

Evon

--

Evon Silvia PLS
Geomatics Specialist
517 SW 2nd Street, Suite 400, Corvallis, OR 97333
P: (541) 452-8502

E: esilvia@quantumspatial.com

On Wed, Mar 23, 2016 at 5:29 AM, Lewis Graham <lgraham@geocue.com> wrote:

Just a bit (pun intended) of history –

When we did the very first LAS (prior to it being turned over to the ASPRS), the “edge of swath” bit was intended to allow a user to trim “bad” data.

As you probably recall, the oscillating scanners used to be unreliable from the perspective of position encoding during mirror reversal.

The idea was that one could detect the edge of scan pulse, look up the GPS time stamp and then remove points near this point with near meaning from the time perspective (you could not do it from position due to the encoder issues).

There were all sorts of “best practice” approaches such as to routinely clip x% at the edge of swath and so forth.

Of course, the correct answer was that the manufacture should remove known bad data prior to the first encoding and that, I think, is where things went.

So the edge of scan is an old artifact of a bad practice we were all engaged in back in the early days when the sensors were still really somewhat experimental.

Perhaps we could simply redefine this as “edge of swath” and use it for generating coverage polygons. If it gets clipped out in a thinning/clipping process, then we should not worry about it.

An alternative is to simply deprecate it entirely.

Regards,

Lewis

Lewis Graham

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From: Christian Sevcik [mailto:csevcik@riegl.com]

Sent: Wednesday, March 16, 2016 11:40

To: Heidemann, Hans <kheidemann@usgs.gov>

Cc: Evon Silvia <esilvia@quantumspatial.com>; Lewis Graham <lgraham@geocue.com>; Michael Rosen <mrosen@lizardtech.com>; sdharmapuri@mbakercorp.com; Wanning Peng <wpeng@esri.com>; Arttu Soinen <arttu.soininen@kolumbus.fi>; Christopher Parrish <Christopher.Parrish@oregonstate.edu>; David Reid <david.reid@optech.com>; Derek Morris <dmorris@geocue.com>; Gerhard Loeffler <Gerhard_Loeffler@trimble.com>; Howard Butler <hobu.inc@gmail.com>; Martin Isenburg (martin.isenburg@gmail.com) <martin.isenburg@gmail.com>; Mike Umansky <mumansky@appliedimagery.com>; Paul Galla <paul.galla@leicaus.com>

Subject: AW: US - Las Working Group - Edge of Flightline flag

Karl,

I get your point and I probably did not make myself clear enough. The software processes the data with parameters controlled by the user. If a full unfiltered,... all the things you put in blue below.. is required, it can be done. It is not a black box, out of control processing engine. So, if you order the data from your service provider with no processing applied, it is perfectly possible.

But I know people are using the software to further process the data and create some kind of deliverables. And this includes thinning, clipping, merging,..., so we have to provide these functions. But again, it is the user who controls the amount of processing applied to the data.

This makes sense?

Christian

DI Christian Sevcik

Manager | Strategic Software Alliances



RIEGL Laser Measurement Systems GmbH

Riedenburgstrasse 48, 3580 Horn, Austria

Phone: +43-2982-4211

Fax: +43-2982-4210

e-mail: csevcik@riegl.com

www: <http://www.riegl.com>

Von: Heidemann, Hans [<mailto:kheidemann@usgs.gov>]

Gesendet: Mittwoch, 16. März 2016 17:03

An: Christian Sevcik

Cc: Evon Silvia; Lewis Graham; Michael Rosen; sdharmapuri@mbakercorp.com; Wanning Peng; Arttu Soininen; Christopher Parrish; David Reid; Derek Morris; Gerhard Loeffler; Howard Butler; Martin Isenburg (martin.isenburg@gmail.com); Mike Umansky; Paul Galla

Betreff: Re: US - Las Working Group - Edge of Flightline flag

Thank you Evon.

Christian,

We (the industry) struggled with points in separate files for too many years. I for one do not want to go back and I have worked mighty hard over my career to help develop LAS and ensure that software has been developed such that maximum advantage of point cloud data can be leveraged.

You mention that potentially "... filtering, cleaning, maybe thinning, clipping, merging,... is happening to the data before it is written to a LAS for the first time."

I find this troubling as it imposes irreversible limitations on the data to the end user - the people who are paying for the data. I won't argue that many, many end users may truly only want derivative products, but others want and need the entire "raw" point cloud for their work. Without it, the industry and entire geospatial community is locked into the black-box derivative products that vendors provide, and further research into the wealth of information that point clouds hold is hobbled.

As we stress in our Lidar Base Specification, the USGS regards the full and complete point cloud as the primary data deliverable for a lidar collection. We are paying for a collection; we want the data that has been collected. DEMs, DSMs, Intensity Images -- these are derivative products.

It is my view, overly simplified and perhaps narrowly perceived, that as swaths of point data come out of manufacturers' pre-processing software, proper geometric corrections should have been applied, edge flags assigned, and geometrically unreliable points (those clearly blunderous points outside the rational 3D extents of the swath - either horizontally or vertically, and near-edge points) will have been flagged as Withheld. Minor geometric corrections *to swaths* may be applied to the outputted LAS point cloud files. I *personally* do not favor methods that apply geometric corrections after swaths have been combined and tiled. That said, I fully realize that different data producers use different techniques, and I accept and allow that the proof has to be in the delivered data. But regardless of how good that data is, we here have a responsibility to know more about its lineage -- kinda like knowing your fancy restaurant dinner has no allergens or GMOs in it. Doesn't mean you won't eat it, but you have to know. This is why we require delivery of full, complete swaths -- in their final geometry -- as a principle deliverable.

As most of the recipients here are aware, I am still on my overarching, seemingly life-long crusade to move the industry past the entire tiling debacle with the development of full end-to-end swath-based lidar production, processing, and exploitation software. We are all wasting mountains of time and money on tiles. Obviously, the requirements and "standards" we have established thus far are critical foundation pieces for that goal.

Karl

H. Karl Heidemann, GISP, CMS

Physical Scientist, Lidar Science

U.S. Geological Survey

Mundt Federal Building

47914 252nd Street

Sioux Falls, SD 57198

605-594-2861

kheidemann@usgs.gov

"Nothing matters very much, and very few things ... matter at all."

- Arthur James Balfour

On Wed, Mar 16, 2016 at 3:41 AM, Christian Sevcik <csevcik@riegl.com> wrote:

Evon,

Thanks a lot for your reply. It is a bit of an eye opener, as it seems we are looking at the same topic from different angles.

Our workflow is somewhere between the scanner and the LAS file, therefore some processing in terms of filtering, cleaning, maybe thinning, clipping, merging,... is happening to the data before it is written to a LAS for the first time. In my understanding the characteristics, which qualify a point as edge of flight line are set during acquisition and due to some of processing steps mentioned above, probably not survive until the LAS file is written.

The discussion with you guys shed some light on the topic and I will definitely share this with our developers.

Thank you!

Christian

DI Christian Sevcik

Manager | Strategic Software Alliances



RIEGL Laser Measurement Systems GmbH

Riedenburgstrasse 48, 3580 Horn, Austria

Phone: +43-2982-4211

Fax: +43-2982-4210

e-mail: csevcik@riegl.com

www: <http://www.riegl.com>

Von: Evon Silvia [<mailto:esilvia@quantumspatial.com>]

Gesendet: Dienstag, 15. März 2016 17:41

An: Christian Sevcik

Cc: Heidemann, Hans; Lewis Graham; Michael Rosen; sdharmapuri@mbakercorp.com; Wanning Peng; Arttu Soininen; Christopher Parrish; David Reid; Derek Morris; Gerhard Loeffler; Howard Butler; Martin Isenburg (martin.isenburg@gmail.com); Mike Umansky; Paul Galla

Betreff: Re: US - Las Working Group - Edge of Flightline flag

Christian,

I would think that it depends on which data you're talking about. Generally, for filtering in post-processing software like LAStools, TerraSolid, GeoCue, LP360, RiProcess, etc, I wouldn't expect those software packages to re-apply the edge flag unless they're running a routine designed for that purpose. That would be a nearly impossible expectation to meet, especially on tiled data.

The discussion gets more interesting for the software producing/extracting swaths from the raw sensor data – in your case, RiAnalyze probably. In that case, the software should be producing edge flags on every line because the user would reasonably expect valid data straight from the sensor. Consider this example, arbitrary swath:



If I extract every point, I would expect RiAnalyze to correctly apply edge flags to the orange points on the ends of every line.

But what if a filter is being applied in the extraction software, though? For example, a 2° edge clip would remove the orange and green points, leaving just the black and red. Should the red be flagged as edge? Well... I waffled back and forth about 8 times while writing this email so I honestly don't know. I wouldn't *expect* the edge flags, but they would still be useful in both cases for all the same reasons that they were useful in the first place. I can't think of a reason *not* to flag them, except in the unusual circumstance where you want to merge clipped and unclipped data... which I've had to do a several times recently. Maybe make it optional?

For another example, if I only extracted every 5th pulse for faster quicklooking, the original right-hand edge point would be lost.



Should the red point be flagged as an edge? I'm not sure, but probably not in this case. Final data is very rarely produced in this way as far as I know. For the example that you proposed of filtering based on return, I probably wouldn't expect edge flags.

This is very similar to the question of what should be done after running an atmospheric noise filter. If I have 5 returns and I filter out the first 2, should I renumber the returns so that they are "x of 3" instead of "x of 5"? Most people don't, even though there are now only 3 points in the pulse. **If you never actually remove the data and only classify it like Karl insists, this entire discussion is completely moot.** In my opinion, questions like these are the best reason to deliver all data and use Withheld flags. (Tangent: If manufacturers added an option to FLAG clipped points as Withheld instead of removing it, that would make the lives of data vendors immensely easier, as Karl's preference is a requirement for all 3DEP contracts.)

In the end, I think my answer is that users would expect edge flags on both ends of every line unless a filter is applied. For filtered data, it's up to the user to add edge flags. The notable exception for me is when applying an edge clip, in which case I would leave it up to the user.

The others on this list are invited to disagree. :)

Evon

--

Evon Silvia PLS
Geomatics Specialist
517 SW 2nd Street, Suite 400, Corvallis, OR 97333
P: (541) 452-8502

E: esilvia@quantumspatial.com

On Tue, Mar 15, 2016 at 1:33 AM, Christian Sevcik <csevcik@riegl.com> wrote:

Karl,

Evon,

Thanks for the input. This sounds good to me.

I get your arguments of either flagging single and first or single and last returns, or alternating at the beginning and end of a scanline.

Would you expect flagged points at every single scan line?

I am thinking of datasets filtered for certain purpose, for instance single and last returns for DTM creation, or single and first for DSM. In this case some of the flagged points won't make it to the LAS file. So you end up with some lines fully flagged, some partially and maybe some not flagged at all. Very likely there are still enough points to calculate for a fairly good boundary, but it is definitely not a perfect fit. Any concerns here?

Thanks

Christian

DI Christian Sevcik

Manager | Strategic Software Alliances



RIEGL Laser Measurement Systems GmbH

Riedenburgstrasse 48, 3580 Horn, Austria

Phone: [+43-2982-4211](tel:+43-2982-4211)

Fax: [+43-2982-4210](tel:+43-2982-4210)

e-mail: csevcik@riegl.com

www: <http://www.riegl.com>

Von: Heidemann, Hans [mailto:kheidemann@usgs.gov]

Gesendet: Montag, 14. März 2016 19:16


An: Evon Silvia

Cc: Christian Sevcik; Lewis Graham; Michael Rosen; sdharmapuri@mbakercorp.com; Wanning Peng; Arttu Soininen; Christopher Parrish; David Reid; Derek Morris; Gerhard Loeffler; Howard Butler; Martin Isenburg (martin.isenburg@gmail.com); Mike Umansky; Paul Galla

Betreff: Re: US - Las Working Group - Edge of Flightline flag

and using the Withheld Flag for the outer points still retains the edge points so, even though they would be also flagged as withheld, you are not prevented from building those polygons.

Karl

 Das Bild wurde vom Absender entfernt.

H. Karl Heidemann, GISP, CMS

Physical Scientist, Lidar Science

U.S. Geological Survey

Mundt Federal Building

47914 252nd Street

Sioux Falls, SD 57198

[605-594-2861](tel:605-594-2861)

kheidemann@usgs.gov

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On Mon, Mar 14, 2016 at 12:57 PM, Evon Silvia <esilvia@quantumspatial.com> wrote:

Good point on the value on simply having a point on either edge of the swath. Coverage polygons would be so much easier if the edge flag was properly encoded all the time and no points were ever deleted.

Evon

On Mon, Mar 14, 2016 at 9:14 AM, Heidemann, Hans <kheidemann@usgs.gov> wrote:

lol

And I would not disagree with Evon on his point about the Last Return over First return. In most all cases, it really doesn't matter all that much. Evon knows considerably more than I do about internal coding nuances.

I would disagree on the point of the edge flag. In my mind, the point is, as Christian initially asserted, to more easily identify a precise edge of the swath data. My biggest concern is, perhaps, a semantic one: Evon stated that it allows a simpler means to "clip" the edges. The term "clip" is too often understood to mean "remove" -- this approach is wholly unacceptable. If the outer extremes of a swath need to be "removed" (as the term "clip" would imply), that should be handled by flagging those points with the Withheld Flag. That is what the Withheld Flag has always been intended to signify. Why it has been so widely ignored (pun intended) is a topic for a completely different rant. ;-)

Thanks Evon!
See you in Ft. Worth?

Karl

H. Karl Heidemann, GISP, CMS

Physical Scientist, Lidar Science

U.S. Geological Survey

Mundt Federal Building

47914 252nd Street

Sioux Falls, SD 57198

605-594-2861

kheidemann@usgs.gov

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On Mon, Mar 14, 2016 at 11:01 AM, Evon Silvia <esilvia@quantumspatial.com> wrote:

Hello Christian,

I agree with Karl on all points, except a minor point for Question 3: I would suggest flagging the LAST return for the final pulse to hit a particular face and the FIRST return of the first pulse to hit a face. Most sorting algorithms would sort points in that manner (chronologically by timestamp, then by return), so that would ensure adjacency.

The point of the edge flag is to give users the ability to conveniently "clip" the edges of a flightline for whatever reason they deem worthy. Two examples off the top of my head include geometric distortion at flightline edges and clipping/flagging/filtering overlap areas for setting the Overlap bit. This procedure is significantly simplified by the addition of a Edge Flag.

Great question! Definitely a point that can be clarified in the spec. I don't believe there was any intent to change the definition of the Edge Flag between the point formats.

Evon

--

Evon Silvia PLS
Geomatics Specialist
517 SW 2nd Street, Suite 400, Corvallis, OR 97333
P: (541) 452-8502

E: esilvia@quantumspatial.com

On Mon, Mar 14, 2016 at 8:54 AM, Heidemann, Hans <kheidemann@usgs.gov> wrote:

H Christian,

This is only my opinion and may not represent even a plurality of the committee.

Question 1: It seems to me that, if you can flag the last point of a rotating polygon scanline, it should not be overly difficult to flag the next point, which would be the first point of the next scanline ? Perhaps not; I don't claim to know the internal intricacies of your system processing.

Question 2: I would think that the split between forward and reverse arcs would/should provide a very close approximation of the edges of the swath. Obviously, variations in flight attitude will prevent this from being an absolutely exact boundary, but the same limitation exists for all systems.

Question 3: I would suggest flagging the First Return. Yes, on the outbound scan, there may likely be additional points beyond the First, but the opposite will happen on the inbound scan as well, so it's a pick your poison kind of question. The difference is not likely to be significant either way, flagging the First seems like it would be simpler.

Flagging all returns of the pulse is likely to cause further complexity in downstream processing for MOST processes; the additional effort should be placed on the fewer activities that would benefit from that scheme.

Karl

H. Karl Heidemann, GISP, CMS

Physical Scientist, Lidar Science

U.S. Geological Survey

Mundt Federal Building

47914 252nd Street

Sioux Falls, SD 57198

[605-594-2861](tel:605-594-2861)

kheidemann@usgs.gov

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On Mon, Mar 14, 2016 at 9:29 AM, Christian Sevcik <csevcik@riegl.com> wrote:

Hello LWG,

We received a request to populate the edge of flight line flag.

According to the standard - I refer to las specification version 1.4 r13, July 2013- the flag is defined as:

For point data records 0-5

"Edge of Flight Line: The Edge of Flight Line data bit has a value of 1 only when the point is at the end of a scan. It is the last point on a given scan line before it changes direction."

For point data records 6-10

"Edge of Flight Line: The Edge of Flight Line data bit has a value of 1 only when the point is at the end of a scan. It is the last point on a given scan line before it changes direction or the mirror facet changes. Note that this field has no meaning for 360° Field of View scanners (such as Mobile LIDAR scanners) and should not be set."

This brings up 3 questions and I wonder, if there is consent within the group ;-)

Definition 1 can only apply to oscillating mirror scanners, as there is no change in direction for a rotating polygon wheel mirror scanners.

This also means that there is no edge of flightline flag in LAS files version 1.1 -1.3 for polygon wheel scanners.

Definition 2 explicitly addresses facet change and therefore allows to set this flag for polygon wheel scanners for LAS 1.4 and point data record format 6 -10.

As it is stated, only the last point before a facet change can be flagged as edge of flight line, 'edge points' are created on one side of the flight line only. As I understand the intention of the flag is to quickly calculate for the ground coverage of a flightline, but we seem to get stuck here.

Question 2 is about circular scan patterns. There is neither a change in direction, nor a change of facet. For computational reasons we split a circle into a forward arc and a backward arc. Would it be safe to introduce such artificial edges?

The third question is about the returns to be flagged. Although it is not written in the standard, we assume all returns of a 'edge of flightline' pulse get the flag.

Can anyone agree on that?

I would appreciate your comment on this.

Thanks
Christian

DI Christian Sevcik
Manager| Strategic Software Alliances

RIEGL Laser Measurement Systems GmbH
Riedenburgstrasse 48, 3580 Horn, Austria
Phone: [+43-2982-4211](tel:+43-2982-4211)
Fax: [+43-2982-4210](tel:+43-2982-4210)
e-mail: csevcik@riegl.com
www: <http://www.riegl.com>

Evon Silvia <esilvia@quantumspatial.com>
To: Colin Cooper <cocooper@quantumspatial.com>

Thu, Apr 14, 2016 at 10:49 AM

----- Forwarded message -----

From: **Lewis Graham** <lgraham@geocue.com>

Date: Tue, Mar 29, 2016 at 10:26 AM

Subject: RE: US - Las Working Group - Edge of Flightline flag

To: Evon Silvia <esilvia@quantumspatial.com>, Christian Sevcik <csevcik@riegl.com>

Cc: "Heidemann, Hans" <kheidemann@usgs.gov>, Michael Rosen <mrosen@lizardtech.com>, "sdharmapuri@mbakercorp.com" <sdharmapuri@mbakercorp.com>, Wanning Peng <wpeng@esri.com>, Arttu Soininen <arttu.soininen@kolumbus.fi>, Christopher Parrish <Christopher.Parrish@oregonstate.edu>, David Reid <david.reid@optech.com>, Derek Morris <dmorris@geocue.com>, Gerhard Loeffler <Gerhard_Loeffler@trimble.com>, Howard Butler <hobu.inc@gmail.com>, "Martin Isenburg (martin.isenburg@gmail.com)" <martin.isenburg@gmail.com>, Mike Umansky <mumansky@appliedimager.com>, Paul Galla <paul.galla@leica.com>

Again, the edge of flight line cannot be determined until geocoding/geometric correction in object space is complete.

LAS was intended to be "close to the metal" so this information is generally not known at encoding time.

Thus the true original intent of edge of scan was the pulse that was emitted just as the mirror was changing direction or the node changed on a rotating prism. A return from this pulse is not necessarily the edge of a flight line in ground space and thus this bit cannot be used to reliably draw the boundary in object (ground space) – although it will, of course, be very close to the true footprint.

With this in mind, it would be quite strange not to encode all the returns with this bit (if we continue to use the meaning of "edge" in sensor space).

I will be the first to admit that the definition in the LAS specification could stand some clarification. The original specification was not careful about distinguishing between a "pulse" and a "point." We need to clean this up.

We can make this whatever folks want – I am just pointing out the legacy and the fact that we do not generally know which returns of which points are on the edge of a flight line at the time this bit needs to be set.

As the expression goes, I don't have much of a dog in this hunt. We never use this bit in our own code because we seldom find it "correctly" set, if it is set at all.

Best Regards,

Lewis

Lewis Graham

GeoCue Group

9668 Madison Blvd., Suite 202

Madison, AL USA 35758

01-256-461-8289

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From: Evon Silvia [mailto:esilvia@quantumspatial.com]

Sent: Tuesday, March 29, 2016 11:40

To: Christian Sevcik <csevcik@riegl.com>

Cc: Lewis Graham <lgraham@geocue.com>; Heidemann, Hans <kheidemann@usgs.gov>; Michael Rosen <mrosen@lizardtech.com>; sdharmapuri@mbakercorp.com; Wanning Peng <wpeng@esri.com>; Arttu Soinen <arttu.soininen@kolumbus.fi>; Christopher Parrish <Christopher.Parrish@oregonstate.edu>; David Reid <david.reid@optech.com>; Derek Morris <dmorris@geocue.com>; Gerhard Loeffler <Gerhard_Loeffler@trimble.com>; Howard Butler <hobu.inc@gmail.com>; Martin Isenburg (martin.isenburg@gmail.com) <martin.isenburg@gmail.com>; Mike Umansky <mumansky@appliedimagery.com>; Paul Galla <paul.galla@leicaus.com>

Subject: Re: US - Las Working Group - Edge of Flightline flag

Although I understand Lewis's intent, I personally disagree with his suggestion to flag every point in the pulse. I don't think anyone reading the specification would expect to see several points at the edge of each scan line. From the LAS 1.4 specification (emphasis added):

Edge of Flight Line: The Edge of Flight Line data bit has a value of 1 only when the point is at the end of a scan. It is the last point on a given scan line before it changes direction.

The specification is singular, not plural, telling me that it should be the edge point, not the entire pulse, that should be flagged. In addition, it is far more usable to only have one point flagged instead of them all. Coverage polygons and edge clip routines would both be complicated by having multiple points on each edge.

Evon

On Tue, Mar 29, 2016 at 9:33 AM, Christian Sevcik <csevcik@riegl.com> wrote:

Thanks Lewis, it seems our little plan just run aground.. ;-)

So you are saying all returns should be flagged?

I understand there are valid arguments on both sides, flag all and flag single/first/last only.

Technically both can be done, but what is closest to the specification?

Christian

DI Christian Sevcik

Manager | Strategic Software Alliances



RIEGL Laser Measurement Systems GmbH

Riedenburgstrasse 48, 3580 Horn, Austria

Phone: +43-2982-4211

Fax: +43-2982-4210

e-mail: csevcik@riegl.com

www: <http://www.riegl.com>

Von: Lewis Graham [<mailto:lgraham@geocue.com>]

Gesendet: Dienstag, 29. März 2016 14:05

An: Christian Sevcik; Evon Silvia

Cc: Heidemann, Hans; Michael Rosen; sdharmapuri@mbakercorp.com; Wanning Peng; Arttu Soinen; Christopher Parrish; David Reid; Derek Morris; Gerhard Loeffler; Howard Butler; Martin Isenburg (martin.isenburg@gmail.com); Mike Umansky; Paul Galla

Betreff: RE: US - Las Working Group - Edge of Flightline flag

Two points (ha, another pun) I would make:

- If we retain edge of scan (it sounds as if there is consensus that we should) than all returns associated with the edge of scan outbound pulse should be flagged.

- It is a misconception that the Edge of Scan flagged pulses represent the true edge of a flight line in object space. It depends on the pitch, yaw, roll of the sensor at the time of the pulse as well as the terrain. It was never intended to mean the edge of light line in object (ground) space.

Best Regards,

Lewis

Lewis Graham

GeoCue Group

9668 Madison Blvd., Suite 202

Madison, AL USA 35758

01-256-461-8289

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From: Christian Sevcik [<mailto:csevcik@riegl.com>]

Sent: Tuesday, March 29, 2016 06:55

To: Evon Silvia <esilvia@quantumspatial.com>; Lewis Graham <lgraham@geocue.com>

Cc: Heidemann, Hans <kheidemann@usgs.gov>; Michael Rosen <mrosen@lizardtech.com>;
sdharmapuri@mbakercorp.com; Wanning Peng <wpeng@esri.com>; Arttu Soininen
<arttu.soininen@kolumbus.fi>; Christopher Parrish <Christopher.Parrish@oregonstate.edu>; David Reid
<david.reid@optech.com>; Derek Morris <dmorris@geocue.com>; Gerhard Loeffler
<Gerhard_Loeffler@trimble.com>; Howard Butler <hobu.inc@gmail.com>; Martin Isenburg
(martin.isenburg@gmail.com) <martin.isenburg@gmail.com>; Mike Umansky
<mumansky@appliedimagery.com>; Paul Galla <paul.galla@leicaus.com>

Subject: AW: US - Las Working Group - Edge of Flightline flag

Thank you all for sharing the insights.

From what was discussed here, we found it is best to flag single and last returns on the left and right edge of the swath.

Christian

DI Christian Sevcik

Manager | Strategic Software Alliances



RIEGL Laser Measurement Systems GmbH

Riedenburgerstrasse 48, 3580 Horn, Austria

Phone: +43-2982-4211

Fax: +43-2982-4210

e-mail: csevcik@riegl.com

www: <http://www.riegl.com>

Von: Evon Silvia [<mailto:esilvia@quantumspatial.com>]

Gesendet: Mittwoch, 23. März 2016 16:41

An: Lewis Graham

Cc: Christian Sevcik; Heidemann, Hans; Michael Rosen; sdharmapuri@mbakercorp.com; Wanning Peng; Arttu Soininen; Christopher Parrish; David Reid; Derek Morris; Gerhard Loeffler; Howard Butler; Martin Isenburg (martin.isenburg@gmail.com); Mike Umansky; Paul Galla

Betreff: Re: US - Las Working Group - Edge of Flightline flag

Thanks for the background, Lewis. One thing to note is that our experience is that the issue of poor geometry at the swath edges is still a very real and present problem in high resolution and high accuracy LiDAR, both for the oscillating mirror and rotating prism scanners. You are correct, though, that newer scanners have reduced this error significantly over previous generations. My theory is that the error we are observing has everything to do with the obliqueness as you get further off-nadir, rather than the mechanical properties of the scanner itself like with previous generations.

Still, my point is that this isn't just a problem left in the history books and remains relevant with current technology. In fact, I've spent the past 3 days improving our edge filtering algorithms...

Evon

--

Evon Silvia PLS
Geomatics Specialist
517 SW 2nd Street, Suite 400, Corvallis, OR 97333
P: (541) 452-8502

E: esilvia@quantumspatial.com

On Wed, Mar 23, 2016 at 5:29 AM, Lewis Graham <lgraham@geocue.com> wrote:

Just a bit (pun intended) of history –

When we did the very first LAS (prior to it being turned over to the ASPRS), the “edge of swath” bit was intended to allow a user to trim “bad” data.

As you probably recall, the oscillating scanners used to be unreliable from the perspective of position encoding during mirror reversal.

The idea was that one could detect the edge of scan pulse, look up the GPS time stamp and then remove points near this point with near meaning from the time perspective (you could not do it from position due to the encoder issues).

There were all sorts of “best practice” approaches such as to routinely clip x% at the edge of swath and so forth.

Of course, the correct answer was that the manufacture should remove known bad data prior to the first encoding and that, I think, is where things went.

So the edge of scan is an old artifact of a bad practice we were all engaged in back in the early days when the sensors were still really somewhat experimental.

Perhaps we could simply redefine this as “edge of swath” and use it for generating coverage polygons. If it gets clipped out in a thinning/clipping process, then we should not worry about it.

An alternative is to simply deprecate it entirely.

Regards,

Lewis

Lewis Graham

GeoCue Group

9668 Madison Blvd., Suite 202

Madison, AL USA 35758

01-256-461-8289

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From: Christian Sevcik [mailto:csevcik@riegl.com]

Sent: Wednesday, March 16, 2016 11:40

To: Heidemann, Hans <kheidemann@usgs.gov>

Cc: Evon Silvia <esilvia@quantumspatial.com>; Lewis Graham <lgraham@geocue.com>; Michael Rosen <mrosen@lizardtech.com>; sdharmapuri@mbakercorp.com; Wanning Peng <wpeng@esri.com>; Arttu Soinen <arttu.soininen@kolumbus.fi>; Christopher Parrish <Christopher.Parrish@oregonstate.edu>; David Reid <david.reid@optech.com>; Derek Morris <dmorris@geocue.com>; Gerhard Loeffler <Gerhard_Loeffler@trimble.com>; Howard Butler <hobu.inc@gmail.com>; Martin Isenburg (martin.isenburg@gmail.com) <martin.isenburg@gmail.com>; Mike Umansky <mumansky@appliedimagery.com>; Paul Galla <paul.galla@leicaus.com>

Subject: AW: US - Las Working Group - Edge of Flightline flag

Karl,

I get your point and I probably did not make myself clear enough. The software processes the data with parameters controlled by the user. If a full unfiltered,... all the things you put in blue below.. is required, it can be done. It is not a black box, out of control processing engine. So, if you order the data from your service provider with no processing applied, it is perfectly possible.

But I know people are using the software to further process the data and create some kind of deliverables. And this includes thinning, clipping, merging,..., so we have to provide these functions. But again, it is the user who controls the amount of processing applied to the data.

This makes sense?

Christian

DI Christian Sevcik

Manager | Strategic Software Alliances



RIEGL Laser Measurement Systems GmbH

Riedenburgstrasse 48, 3580 Horn, Austria

Phone: +43-2982-4211

Fax: +43-2982-4210

e-mail: csevcik@riegl.com

www: <http://www.riegl.com>

Von: Heidemann, Hans [<mailto:kheidemann@usgs.gov>]

Gesendet: Mittwoch, 16. März 2016 17:03

An: Christian Sevcik

Cc: Evon Silvia; Lewis Graham; Michael Rosen; sdharmapuri@mbakercorp.com; Wanning Peng; Arttu Soinenen; Christopher Parrish; David Reid; Derek Morris; Gerhard Loeffler; Howard Butler; Martin Isenburg (martin.isenburg@gmail.com); Mike Umansky; Paul Galla

Betreff: Re: US - Las Working Group - Edge of Flightline flag

Thank you Evon.

Christian,

We (the industry) struggled with points in separate files for too many years. I for one do not want to go back and I have worked mighty hard over my career to help develop LAS and ensure that software has been developed such that maximum advantage of point cloud data can be leveraged.

You mention that potentially "... filtering, cleaning, maybe thinning, clipping, merging,... is happening to the data before it is written to a LAS for the first time."

I find this troubling as it imposes irreversible limitations on the data to the end user - the people who are paying for the data. I won't argue that many, many end users may truly only want derivative products, but others want and need the entire "raw" point cloud for their work. Without it, the industry and entire geospatial community is locked into the black-box derivative products that vendors provide, and further research into the wealth of information that point clouds hold is hobbled.

As we stress in the our Lidar Base Specification, the USGS regards the full and complete point cloud as the primary data deliverable for a lidar collection. We are paying for a collection; we want the data that has been collected. DEMs, DSMs, Intensity Images -- these are derivative products.

It is my view, overly simplified and perhaps narrowly perceived, that as swaths of point data come out of manufacturers' pre-processing software, proper geometric corrections should have been applied, edge flags assigned, and geometrically unreliable points (those clearly blunderous points outside the rational 3D extents of the swath - either horizontally or vertically, and near-edge points) will have been flagged as Withheld. Minor geometric corrections *to swaths* may be applied to the outputted LAS point cloud files. I *personally* do not favor methods that apply geometric corrections after swaths have been combined and tiled. That said, I fully realize that different data producers use different techniques, and I accept and allow that the proof has to be in the delivered data. But regardless of how good that data is, we here have a responsibility to know more about it's lineage -- kinda like knowing your fancy restaurant dinner has no allergens or GMOs in it. Doesn't mean you won't eat it, but you have to know. This is why we require delivery of full, complete swaths -- in their final geometry -- as a principle deliverable.

As most of the recipients here are aware, I am still on my overarching, seemingly life-long crusade to move the industry past the entire tiling debacle with the development of full end-to-end swath-based lidar production, processing, and exploitation software. We are all wasting mountains of time and money on tiles. Obviously, the requirements and "standards" we have established thus far are critical foundation pieces for that goal.

Karl

H. Karl Heidemann, GISP, CMS

Physical Scientist, Lidar Science

U.S. Geological Survey

Mundt Federal Building

47914 252nd Street

Sioux Falls, SD 57198

605-594-2861

kheidemann@usgs.gov

"Nothing matters very much, and very few things ... matter at all."

- Arthur James Balfour

On Wed, Mar 16, 2016 at 3:41 AM, Christian Sevcik <csevcik@riegl.com> wrote:

Evon,

Thanks a lot for your reply. It is a bit of an eye opener, as it seems we are looking at the same topic from different angles.

Our workflow is somewhere between the scanner and the LAS file, therefore some processing in terms of filtering, cleaning, maybe thinning, clipping, merging,... is happening to the data before it is written to a LAS for the first time. In my understanding the characteristics, which qualify a point as edge of flight line are set during acquisition and due to some of processing steps mentioned above, probably not survive until the LAS file is written.


The discussion with you guys shed some light on the topic and I will definitely share this with our developers.

Thank you!

Christian

DI Christian Sevcik

Manager | Strategic Software Alliances

 Logo_Schriftzug_rgb_R_

RIEGL Laser Measurement Systems GmbH

Riedenburgstrasse 48, 3580 Horn, Austria

Phone: +43-2982-4211

Fax: +43-2982-4210

e-mail: csevcik@riegl.com

www: <http://www.riegl.com>

Von: Evon Silvia [mailto:esilvia@quantumspatial.com]

Gesendet: Dienstag, 15. März 2016 17:41

An: Christian Sevcik

Cc: Heidemann, Hans; Lewis Graham; Michael Rosen; sdharmapuri@mbakercorp.com; Wanning Peng; Arttu Soininen; Christopher Parrish; David Reid; Derek Morris; Gerhard Loeffler; Howard Butler; Martin Isenburg (martin.isenburg@gmail.com); Mike Umansky; Paul Galla

Betreff: Re: US - Las Working Group - Edge of Flightline flag

Christian,

I would think that it depends on which data you're talking about. Generally, for filtering in post-processing software like LAStools, TerraSolid, GeoCue, LP360, RiProcess, etc, I wouldn't expect those software packages to re-apply the edge flag unless they're running a routine designed for that purpose. That would be a nearly impossible expectation to meet, especially on tiled data.

The discussion gets more interesting for the software producing/extracting swaths from the raw sensor data – in your case, RiAnalyze probably. In that case, the software should be producing edge flags on every line because the user would reasonably expect valid data straight from the sensor. Consider this example, arbitrary swath:



If I extract every point, I would expect RiAnalyze to correctly apply edge flags to the orange points on the ends of every line.

But what if a filter is being applied in the extraction software, though? For example, a 2° edge clip would remove the orange and green points, leaving just the black and red. Should the red be flagged as edge? Well... I waffled back and forth about 8 times while writing this email so I honestly don't know. I wouldn't *expect* the edge flags, but they would still be useful in both cases for all the same reasons that they were useful in the first place. I can't think of a reason *not* to flag them, except in the unusual circumstance where you want to merge clipped and unclipped data... which I've had to do a several times recently. Maybe make it optional?

For another example, if I only extracted every 5th pulse for faster quicklooking, the original right-hand edge point would be lost.



Should the red point be flagged as an edge? I'm not sure, but probably not in this case. Final data is very rarely produced in this way as far as I know. For the example that you proposed of filtering based on return, I probably wouldn't expect edge flags.

This is very similar to the question of what should be done after running an atmospheric noise filter. If I have 5 returns and I filter out the first 2, should I renumber the returns so that they are "x of 3" instead of "x of 5"? Most people don't, even though there are now only 3 points in the pulse. **If you never actually remove the data and only classify it like Karl insists, this entire discussion is completely moot.** In my opinion, questions like these are the best reason to deliver all data and use Withheld flags. (Tangent: If manufacturers added an option to FLAG clipped points as Withheld instead of removing it, that would make the lives of data vendors immensely easier, as Karl's preference is a requirement for all 3DEP contracts.)

In the end, I think my answer is that users would expect edge flags on both ends of every line unless a filter is applied. For filtered data, it's up to the user to add edge flags. The notable exception for me is when applying an edge clip, in which case I would leave it up to the user.

The others on this list are invited to disagree. :)

Evon

--

Evon Silvia PLS
Geomatics Specialist
517 SW 2nd Street, Suite 400, Corvallis, OR 97333
P: (541) 452-8502

E: esilvia@quantumspatial.com

On Tue, Mar 15, 2016 at 1:33 AM, Christian Sevcik <csevcik@riegl.com> wrote:

Karl,

Evon,

Thanks for the input. This sounds good to me.

I get your arguments of either flagging single and first or single and last returns, or alternating at the beginning and end of a scanline.

Would you expect flagged points at every single scan line?

I am thinking of datasets filtered for certain purpose, for instance single and last returns for DTM creation, or single and first for DSM. In this case some of the flagged points won't make it to the LAS file. So you end up with some lines fully flagged, some partially and maybe some not flagged at all. Very likely there are still enough points to calculate for a fairly good boundary, but it is definitely not a perfect fit. Any concerns here?

Thanks

Christian

DI Christian Sevcik

Manager | Strategic Software Alliances



RIEGL Laser Measurement Systems GmbH

Riedenburgstrasse 48, 3580 Horn, Austria

Phone: +43-2982-4211

Fax: +43-2982-4210

e-mail: csevcik@riegl.com

www: <http://www.riegl.com>

Von: Heidemann, Hans [mailto:kheidemann@usgs.gov]

Gesendet: Montag, 14. März 2016 19:16

An: Evon Silvia

Cc: Christian Sevcik; Lewis Graham; Michael Rosen; sdharnapuri@mbakercorp.com; Wanning Peng; Arttu Soinenen; Christopher Parrish; David Reid; Derek Morris; Gerhard Loeffler; Howard Butler; Martin Isenburg

(martin.isenburg@gmail.com); Mike Umansky; Paul Galla

Betreff: Re: US - Las Working Group - Edge of Flightline flag

and using the Withheld Flag for the outer points still retains the edge points so, even though they would be also flagged as withheld, you are not prevented from building those polygons.

Karl

H. Karl Heidemann, GISP, CMS

Physical Scientist, Lidar Science

U.S. Geological Survey

Mundt Federal Building

47914 252nd Street

Sioux Falls, SD 57198

[605-594-2861](tel:605-594-2861)

kheidemann@usgs.gov

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On Mon, Mar 14, 2016 at 12:57 PM, Evon Silvia <esilvia@quantumspatial.com> wrote:

Good point on the value on simply having a point on either edge of the swath. Coverage polygons would be so much easier if the edge flag was properly encoded all the time and no points were ever deleted.

Evon

On Mon, Mar 14, 2016 at 9:14 AM, Heidemann, Hans <kheidemann@usgs.gov> wrote:

lol

And I would not disagree with Evon on his point about the Last Return over First return. In most all cases, it really doesn't matter all that much. Evon knows considerably more than I do about internal coding nuances.

I would disagree on the point of the edge flag. In my mind, the point is, as Christian initially asserted, to more easily identify a precise edge of the swath data. My biggest concern is, perhaps, a semantic one: Evon stated that it allows

a simpler means to "clip" the edges. The term "clip" is too often understood to mean "remove" -- this approach is wholly unacceptable. If the outer extremes of a swath need to be "removed" (as the term "clip" would imply), that should be handled by flagging those points with the Withheld Flag. That is what the Withheld Flag has always been intended to signify. Why it has been so widely ignored (pun intended) is a topic for a completely different rant. ;-)

Thanks Evon!
See you in Ft. Worth?

Karl

H. Karl Heidemann, GISP, CMS

Physical Scientist, Lidar Science

U.S. Geological Survey

Mundt Federal Building

47914 252nd Street

Sioux Falls, SD 57198

605-594-2861

kheidemann@usgs.gov

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On Mon, Mar 14, 2016 at 11:01 AM, Evon Silvia <esilvia@quantumspatial.com> wrote:

Hello Christian,

I agree with Karl on all points, except a minor point for Question 3: I would suggest flagging the LAST return for the final pulse to hit a particular face and the FIRST return of the first pulse to hit a face. Most sorting algorithms would sort points in that manner (chronologically by timestamp, then by return), so that would ensure adjacency.

The point of the edge flag is to give users the ability to conveniently "clip" the edges of a flightline for whatever reason they deem worthy. Two examples off the top of my head include geometric distortion at flightline edges and clipping/flagging/filtering overlap areas for setting the Overlap bit. This procedure is significantly simplified by the addition of a Edge Flag.

Great question! Definitely a point that can be clarified in the spec. I don't believe there was any intent to change the definition of the Edge Flag between the point formats.

Evon

--

Evon Silvia PLS
Geomatics Specialist
517 SW 2nd Street, Suite 400, Corvallis, OR 97333
P: (541) 452-8502

E: esilvia@quantumspatial.com

On Mon, Mar 14, 2016 at 8:54 AM, Heidemann, Hans <kheidemann@usgs.gov> wrote:

H Christian,

This is only my opinion and may not represent even a plurality of the committee.

Question 1: It seems to me that, if you can flag the last point of a rotating polygon scanline, it should not be overly difficult to flag the next point, which would be the first point of the next scanline ? Perhaps not; I don't claim to know the internal intricacies of your system processing.

Question 2: I would think that the split between forward and reverse arcs would/should provide a very close approximation of the edges of the swath. Obviously, variations in flight attitude will prevent this from being an absolutely exact boundary, but the same limitation exists for all systems.

Question 3: I would suggest flagging the First Return. Yes, on the outbound scan, there may likely be additional points beyond the First, but the opposite will happen on the inbound scan as well, so it's a pick your poison kind of question. The difference is not likely to be significant either way, flagging the First seems like it would be simpler. Flagging all returns of the pulse is likely to cause further complexity in downstream processing for MOST processes; the additional effort should be placed on the fewer activities that would benefit from that scheme.

Karl

H. Karl Heidemann, GISP, CMS

Physical Scientist, Lidar Science

U.S. Geological Survey

Mundt Federal Building

47914 252nd Street

Sioux Falls, SD 57198

[605-594-2861](tel:605-594-2861)

kheidemann@usgs.gov

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On Mon, Mar 14, 2016 at 9:29 AM, Christian Sevcik <csevcik@riegl.com> wrote:

Hello LWG,

We received a request to populate the edge of flight line flag.

According to the standard - I refer to las specification version 1.4 r13, July 2013- the flag is defined as:

For point data records 0-5

"Edge of Flight Line: The Edge of Flight Line data bit has a value of 1 only when the point is at the end of a scan. It is the last point on a given scan line before it changes direction."

For point data records 6-10

"Edge of Flight Line: The Edge of Flight Line data bit has a value of 1 only when the point is at the end of a scan. It is the last point on a given scan line before it changes direction or the mirror facet changes. Note that this field has no meaning for 360° Field of View scanners (such as Mobile LIDAR scanners) and should not be set."

This brings up 3 questions and I wonder, if there is consent within the group ;-)

Definition 1 can only apply to oscillating mirror scanners, as there is no change in direction for a rotating polygon wheel mirror scanners.

This also means that there is no edge of flightline flag in LAS files version 1.1 -1.3 for polygon wheel scanners.

Definition 2 explicitly addresses facet change and therefore allows to set this flag for polygon wheel scanners for LAS

1.4 and point data record format 6 -10.

As it is stated, only the last point before a facet change can be flagged as edge of flight line, 'edge points' are created on one side of the flight line only. As I understand the intention of the flag is to quickly calculate for the ground coverage of a flightline, but we seem to get stuck here.

Question 2 is about circular scan patterns. There is neither a change in direction, nor a change of facet. For computational reasons we split a circle into a forward arc and a backward arc. Would it be safe to introduce such artificial edges?

The third question is about the returns to be flagged. Although it is not written in the standard, we assume all returns of a 'edge of flightline' pulse get the flag.

Can anyone agree on that?

I would appreciate your comment on this.

Thanks
Christian

DI Christian Sevcik
Manager| Strategic Software Alliances

RIEGL Laser Measurement Systems GmbH
Riedenburgstrasse 48, 3580 Horn, Austria
Phone: [+43-2982-4211](tel:+43-2982-4211)
Fax: [+43-2982-4210](tel:+43-2982-4210)
e-mail: csevcik@riegl.com
www: <http://www.riegl.com>