Response to Reviewers

Title: **[Technical Note]: Measurement of nuclear fuel assembly's bow from visual inspection's video record**

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Revision Version: 2

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Author Response 2nd revision

Reviewer 1

**Reviewer Comments:**

thanks for the answers.

1. I still do recommend that the manuscript is checked and edited by a native English speaker, to reach a level that is fully satisfactory for publishing
2. In the conclusion §5, there is a specifically serious typo: "Our novel method is fully automatic and therefore prone to human-based errors." (Should be "less prone", or reworded.)
3. Something is wrong with the references, only question marks are shown now, "[?]"
4. I am missing information on how you go from DIP bow angles on Hex sides 1-3-5 to X and Y coordinates for the displacement / bow vectors, per axial plane. I believe this should at least be commented for completeness.

Author Response:

Many thanks for the review. We tried to fix the remaining issues:

1. We agree that the language of the article should be improved at many places, but it is beyond our possibilities to find the necessary native English speaker with relevant expertise. We did our best.

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| 1. We have added the "less" into the sentence. Thank you. |
| 1. There is a problem with submission system which is not able to compile LaTeX file with bibliography. This time I have attached supplementary material, a PDF, with all references fulfilled. Sorry for this issue, do not hesitate to download the supplementary PDF. |
| 1. There is added a new subsection 3.4 which describes this process in more detailed way. |

Reviewer 2

**Reviewer Comments:**

Your changes and explanations have cleared up some open questions and the manuscript has well improved in language. However, some ambiguity remained regarding certain points. As before, they are listed below with some additional remarks and suggestions regarding language and spelling.  
  
Content and Structure:

1. References are missing in text and list.
2. Sentence "This random process allowed the oxidation maps to refer to a diﬀerent FA operation in the reactor core." was claimed to be rephrased but does not appear so in the manuscript. (remark 7 of previous review)
3. Authors' answer to remark 11:  
   We are not able to estimate the camera speed from frames without horizontally oriented object. This is the case of frames, where only rods are present (all features in the frame are oriented vertically). For this reason, we assume constant (or near constant) speed of the camera. If this is not valid, we are not able to stitch video frames in one image overview properly - faster camera would lead to shanked overview image while slower camera creates longer overview image. The same will happen in angle propagation - faster camera decrease measured FA bow, while slower camera increase the measured value.  
     
   Comment:  
   Thank you for the answer. It is still somewhat confusing in the manuscript as it first says that a constant camera speed is mandatory for a reliable measurement while just after that it is said that start and stop should be set in times of maximum camera speed. So this means, one would need constant camera speed and it is assumed like that in the analysis but in reality the camera speed varies and has to find the right moment for start and stop? (page 7)
4. Authors' answer to remark 14:  
   Well, we use opposite, because we are looking from the other side of the fuel. Sorry,this is non-trivial operation if you are not familiar with fuel inspection. The vector has opposite direction because our perspective has flipped. The fuel bow is the same.  
     
   Comment:  
   Just to clarify, it is expected that parallel sides bow in different directions but in the investigation it was found that they bow in the same direction?  
   "…should have the same bow vector magnitude, but opposite direction…" and "…exhibits local bows directed towards the same side." (page 16)

Language:

General:

1. The usage of articles is significantly better than before. However, especially on page 10 in the new explanation as well as in the explanation of the Otsu method, it could use a slight revision.

Page 1 (abstract):

1. „Lead" instead of „led" (3rd sentence)
2. Quotation marks have no function.
3. „…has not yet been validated…" instead of „…has not been yet validated…"  
   Page 2:
4. „…the fuel assemblies nuclear fuel assembly (FA)…" one "fuel assembly" suffices.
5. "…to verify fulfilling the safety criteria…"? The meaning is unclear. Perhaps, rephrasing might help.

Page 4:

1. Suggestion: Combine sentence ("the FA's edge on the image, in spite of the growing…")

Page 5:

1. Suggestion: Split sentence ("…in fuel assemblies. The only possibility…")

Page 6:

1. Suggestion: change sentence "There is typically not possible to take an image of whole  
          side other way than by stitching video frames together." to e.g. "Typically, it is not possible to take an image of an entire side other than by stitching video frames together."
2. "are" instead of "is" in "One of the most important activities is bow and twist measurements."

Page 9:

1. "Gaussian blurring"? It seems like there is a word missing in the symbol explanation.

Page 11:

1. "adaption processes" instead of "adaption process"

Page 12:

1. "2.3 Analysis of frame angles" instead of "frames angles"

Page 13:

1. "from" in the Figure 5 description instead of "form"

Page 19/20:

1. "." Instead of "," should be used in numbering.
2. "planned" instead of "planed"

Author Response:

Many thanks for detailed review. We do our best to incorporate all the suggested corrections and improvements into the text.

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| 1. There is a problem with submission system which is not able to compile LaTeX file with bibliography. This time I have attached supplementary material, a PDF, with all references fulfilled. Sorry for this issue, do not hesitate to download the supplementary PDF. |
| 1. We have answered in the response, but do not replace the sentence in the text. Now the wording is updated in the article as well. Thank you for you double reading, we apologize. New text: “Due to this chemical process, random stains were developed on the fuel cladding surface what allowed to simulate various operating patterns of the fuel rods mock-ups in the reactor core. “ 2. Our experience from the visual inspection is that an operator very often stops the camera and change zoom/light parameters. For this reason, we, maybe inappropriately, added here some guidance how to acquire data processable by our algorithm. This seems to be misleading in the text. I tried to improve the text where camera speed estimation is described to be more straightforward. |

1. No, the supposition and reality are that they bow in the same direction. The only difference is that the point to the camera view has changed (what is "to the right side" on e.g.: face 1 is "to the left side" on face 4). Therefore, the perspective has flipped. So, form the point of FA's view the direction is the same on both sides, but the operator sees it naturally towards opposite sides. We have recalculated pairs of profiles so that it can be visible as the same direction form the operator's point of view as is shown in the picture.

Language:

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| 1. I have added references to documentation of those algorithms (edge detectors, Otsu thresholding and Hough transform) in OpenCV. Hope this helps. |

We fixed and improved all the other language corrections and suggestions. We thank for this comprehensive review.