

CONFIDENTIAL

**Report of the Investigation into the Allegation of Research
Misconduct by Dr. Lei Yao and Dr. Huabei Jiang**

Submitted to Dr. David Norton, Vice President for Research

August 16, 2016

Executive Summary

The Investigation addressed an allegation brought against Dr. Lei Yao and Dr. Huabei Jiang (Respondents) by a Complainant, who wished to remain anonymous, that the Respondents falsified data in a published paper.

According to the University of Florida (UF) policy for Dealing with Conduct in Research, “falsification is manipulating research materials, equipment or processes, or changing or omitting data or results such that the research is not accurately represented in the research record.” Further, a finding of research misconduct, according to the UF policy requires that: 1) there is a significant departure from accepted practices of the relevant research community; and 2) the misconduct be committed intentionally or knowingly or recklessly; and 3) the allegation be proven by a preponderance of evidence.

An Investigation Committee was formed to review the allegation. It concluded that the evidence supported a finding that Respondent Dr. Yao committed research misconduct. The Investigation Committee also concluded that Respondent Dr. Jiang did not commit research misconduct. The evidence showed that he was not aware of or involved closely with this experiment or the analysis, nor did he closely review the paper to ensure that the data supported the paper’s conclusions.

A draft Erratum written by Dr. Jiang was reviewed by the committee. The committee is of the opinion that the erratum does not adequately address the misconduct committed by Dr. Yao.

Description of the Allegation:

According to the Complainant, many data sets (13) of photo-acoustic measurements were recorded and provided to Dr. Yao to develop a finite-element-based algorithm for the reconstruction of absolute temperature distribution in tissue. According to the Complainant, and supported by emails from Dr. Yao (Attachment 3a), Dr. Yao chose three specific data sets which appeared to support the algorithm and rejected the others, nine of which would not have supported the algorithm. Dr. Yao wrote and published a paper scribing the experiment and analysis. The paper carried the names of Dr. Yao, a student, and Dr. Jiang. The paper claimed that the algorithm agreed with the experiment. Specifically, Figure 3 of the paper (Attachment 2) supported the contention that the algorithm worked when in fact the Complainant alleged that Figure 3 was incorrect. In addition, the Complainant alleged that he discussed this issue with Dr. Yao and Dr. Jiang, but the paper had already been published at that time. Following the discussion, no action was taken toward a correction (e.g. Erratum) or a retraction of the

paper. The paper is titled “Finite-element-based photoacoustic imaging of absolute temperature in tissue” and was published September 10, 2014 in Optical Society of America (Attachment 1). The paper in question reports on the development of an algorithm for the reconstruction of absolute temperature distribution in tissue using photoacoustic measurements.

Name and Position of the Respondents:

The Respondent, Dr. Yao, was a Research Assistant Scientist at UF from 2013 through 2015 under the mentorship of Dr. Jiang. He now lives in China. The Respondent, Dr. Jiang, is a professor in the Department of Biomedical Engineering, UF.

Support Information:

The research was supported by the J. Crayton Pruitt Family Endowment.

Applicable Regulations:

UF Regulation 6C1-1.0101; Policy for Dealing with Conduct in Research found at <http://www.admin.ufl.edu/DDD/attach06-07/R10101-0704.pdf>

Institutional Inquiry (Attachment 3, 4 and 5):

The Inquiry was conducted by Dr. David Hahn, Professor and Department Chair, Mechanical and Aerospace Engineering, UF, Dr. Irene Cooke and Mr. Michael Scian, Director and Assistant Director, respectively, of the Division of Research Compliance, Office of Research, UF.

Dr. Hahn had a detailed discussion with the Respondent and co-author Dr. Yao on February 5, 2016. Mr. Scian was also present. Dr. Yao was very forthcoming in his discussion of the manuscript. He explained that the data was very noisy, noting the poor signal-to-noise ratios and the laser pulse-to-pulse fluctuations. He explained that he did a two-part test to include data from a particular run. He first screened to see if the resulting data produced a monotonic increasing temperature value with time. If not, the data was rejected. For this, he used a “qualitative” back-projection (also called the delay-and-sum method) to do this first screening, noting that this method utilized intensity data only from the transducers.

Once this first screening was performed, Dr. Yao then processed the passing data with his FEM algorithm. He stated that he had strong confidence in the algorithm itself, which was his main contribution and that he “expected the (experimental) results to fit” the thermocouple (TC) data, that the “points should be close”. If several data sets passed his first test (i.e. delay-and-sum) as noted above, he stated that he selected the single data point “closest to the TC data”. Dr. Yao was also asked about his understanding and experience with data rejection (i.e. outlier rejection). He explained that he had no experience with such a process and had “never previously” dealt with outlier rejection.

The Inquiry found that the overall data was very noisy and random, and data points appeared to have been “selected” to fit the known algorithm. It was also clear that Dr. Yao rejected data based on trends that did not fit the expected results, namely, did not fit the TC data. Further, this omitted data had not been mentioned in the paper. Thus, even though the paper claimed to have developed an algorithm for the reconstruction of absolute temperature distribution in tissue using photoacoustic measurements, the algorithm had not been validated by the experimental methodology and data. Specifically, the authors failed to include an assessment and treatment of experimental uncertainty and error necessary for others in the community to assess or reproduce the work.

Such a treatment of uncertainty and error is necessary given that the majority of experimental data that was not consistent with the expected results was discarded, and that such treatment is explicitly stated in the journal’s guidelines and ethical standards policy.

Investigation Process:

The Investigation Committee consisted of:

1. Dr. David Hahn, Professor and Department Chair, Mechanical and Aerospace Engineering, College of Engineering, UF.
2. Dr. Mark Orazem, Distinguished Professor, Department of Chemical Engineering, College of Engineering, UF.
3. Dr. David Tanner, Professor, Department of Physics, College of Liberal Arts and Sciences, UF.

Dr. Irene Cooke and Mr. Michael Scian supported the Investigation Committee throughout the process. Dr. Jiang was represented by his attorney, Mr. Eric Lindstrom.

To conduct its investigation, the Investigation Committee reviewed the documents listed below. These have been included in the Investigation Binder. In addition, the Investigation Committee met with Dr. Jiang and his attorney, Mr. Eric Lindstrom, on May 3, 2016. The interview recording was provided to Dr. Jiang for his review and comment.

Information Reviewed by the Investigation Committee

1. Yao L, Huang H and Jiang H. *Finite-element-based photoacoustic imaging of absolute temperature in tissue*. Optical Society of America. 2014 Sept.; 39 5355-5358.
2. Enlarged Figure 3 from journal article.
3. Inquiry Report (with attachments) dated February 16, 2016.
- 3a. Emails from Dr. Yao
4. Respondent’s, Dr. Yao’s, comments on the Inquiry Report dated February 23, 2016.
5. Respondent’s, Dr. Huabei Jiang’s, comments on Inquiry Report dated February 24, 2016.
6. Data presented by Dr. Jiang at his interview of May 3, 2016.
- 6a. Average_Lei Yao PowerPoint
7. Complainant’s raw data presented to Dr. Hahn on January 27, 2016.
8. Ethical Practices Guidelines from Optics Letters.
9. Interview recording and response from Dr. Jiang.
10. An Erratum supplied to the committee by Eric J. Lindstrom dated May 13, 2016.

11. Comments from Dr. Jiang to the draft Investigation Report. The draft Investigation Report was submitted to Dr. Jiang for comment on June 8, 2016. The Respondent replied on August 1, 2016. This final report considered the comments provided by Dr. Jiang to the draft Investigation Report.
- 11a. Revised Erratum

Investigation Analysis

Review of Information

Dr. Hahn examined raw transducer intensity data as forwarded by the Complainant, specifically, three sets of data for each run, with data sets corresponding to the greatest signal-to-noise ratios (Attachment 7). From discussions with both Respondents and with the Complainants, all parties have stipulated that the intensity data is directly proportional to the desired Temperature. In support, during the interview with the Investigative Committee (Attachment 9), the Respondent Dr. Jiang presented Intensity data to demonstrate the down-selection of data based on the overall trend of Intensity vs. Time (Attachment 6). Dr. Hahn examined the distribution of Intensity vs. Time data provided by the Complainant corresponding to the 13 experimental runs times 3 sets (39 total data measurement sets), and concluded that the overall trends with time were highly erratic, with averages revealing no specific relationship of Intensity (i.e. Temperature) vs. Time, and noting very significant error bars. Dr. Hahn did not use the delay-and-sum method directly, but rather processed raw Intensity measurements. The Investigative Committee, the Complainant and the Respondents were all in agreement that the experimental data were very noisy in aggregate.

Interview of the Respondent, Dr. Jiang (Attachment 9)

During his interview, Dr. Jiang stated that he neither reviewed the data produced for the paper nor reviewed the application of the algorithm to the data. He also stated that he did not create Figure 3 in the paper and that Dr. Yao mostly did the research on his own, noting that as a Research Scientist, Dr. Yao worked more independently than a graduate student or post-doc. Dr. Jiang also stated that he was incapable of regenerating Figure 3 in order to include more data or to make estimates of the magnitudes of uncertainties in the data or to add error bars to the data in the figure. Dr. Jiang's contributions to the paper were that he edited it and that he helped initiate the idea of temperature measurement, and that measurements were performed in his lab. During his interview, Dr. Jiang presented a PowerPoint of the data collected for the three cases, each with a different laser power, specifically, Intensity vs. Time data (Attachment 6). The Investigative Committee reviewed the data with Dr. Jiang, and noted that it appeared rather random, consistent with Dr. Hahn's analysis, for all three cases and that in several instances intensity decreased, rather than increased, with time. Dr. Jiang stated that he did not know exactly how Dr. Yao selected data, but that his selection was reasonable based on physics that temperature increases as heating time increases. However, he agreed that Figure 3 was not an accurate representation of the data, as it did not include error bars or related discussion of uncertainty or data rejection. Dr. Jiang admitted that Dr. Yao should have reported multiple data rather than just the data he selected. He also stated that an erratum may be an appropriate course given the facts and the journal policies.

It should be noted that the Ethical Practices guidelines from Optics Letters (Attachment 8), the journal in question, states in part that:

- A research paper should contain sufficient detail and reference to public sources of information to permit the author's peers to repeat the work. Adequate information should be provided with numerical data to allow comparison with other research. Specifically, data should include sources and magnitudes of uncertainties, and graphs representing numerical data should display error bars where appropriate.
- It is an author's responsibility to submit an erratum for publication when a significant error is discovered in one of her or his published reports.

The erratum prepared by Dr. Jiang

An initial erratum was prepared by Dr. Jiang (Attachment 10). The authors named on the erratum are L. Yao and H. Jiang. The erratum specifies that 13 data sets were collected but that 9 were discarded because they did not conform to expectations. One other was analyzed but not reported.

Investigation Findings

According to the UF Policy, "falsification is manipulating research materials, equipment, or processes, or changing or omitting data or results such that the research is not accurately represented in the research record."

The Investigation Committee found that the raw data were too noisy to support Figure 3 in the paper or the conclusion that the data showed that the algorithm worked given the subjective nature of data rejection based on an a priori assumption that the data should follow the rising temperature trend. This data selection process is not within the norms of research as broadly accepted in the engineering and scientific communities. The Investigation Committee also found that Dr. Yao's practice of first screening to see if the resulting data produced a monotonic increasing temperature value with time, and if not, then rejecting the data, constitutes falsification. Further, the Investigation Committee found that once this first screening was performed, Dr. Yao then processed the passing data with his FEM algorithm. Dr. Yao stated that he had strong confidence in the algorithm itself, which was his main contribution and that he "expected the experimental results to fit" the thermocouple data, and that the "points should be close". If several data sets passed the first test, Dr. Yao stated that he selected the single data point "closest to the thermocouple (TC) data". The Investigation Committee found that this practice was also falsification. Thus the allegation met the definition of research misconduct. The Investigation Committee also concluded that Dr. Yao's actions were a significant departure from the accepted scientific practices and that they were committed intentionally. Thus, Dr. Yao committed research misconduct.

The Investigation Committee determined that Dr. Jiang was not aware of or involved closely with this experiment or the analysis, nor did he closely review the paper to ensure that the data supported the paper's conclusions consistent with an acceptable error analysis. Thus, the Investigation Committee concluded that Dr. Jiang did not commit research misconduct. However, the Investigation Committee concluded that Dr. Jiang should have taught Dr. Yao the appropriate techniques with which to reject

data (statistical tests etc.) as well as show him how to report data accurately and completely in the paper. Dr. Jiang should also have more closely reviewed the data produced for the paper as well as the application of the algorithm to the data. Lastly, when Dr. Jiang learned of the issues with the paper he should have more thoroughly investigated them and taken appropriate follow-up action such as a submitting a retraction or an erratum.

The Investigation Committee recommends that Dr. Jiang respond with written steps as to how he will improve supervision in his lab and explain to those under his supervision, including graduate students, post-docs and research scientists, the importance of error analysis and the significance of data rejection. It would also be a good practice going forward to have all contributing authors under his direction on future papers review the targeted journal's ethical practices guidelines.

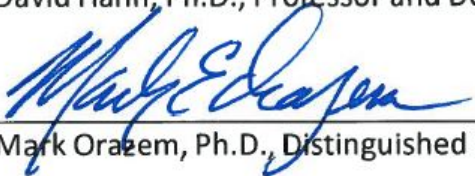
The Investigation Committee believes that the initial (Attachment 10) and revised Erratum (Attachment 11a) as presently written could give a reader who only has access to the Paper and the Errata the impression that the experimental data acquired in this experiment do support the algorithm. It is the conclusion of the Investigation Committee that the totality of the data cannot lead to this conclusion. The errata as written approaches the boundary of research misconduct as it appears to be designed to mislead the reader. The Committee recommends the following be included in a revised Erratum. 1) The statistics of how much data was collected in the experiment versus how much data was used in the paper. 2) The noise, the drifts and the scatter in the data for the paper should be discussed. 3) Some or all of the results in the PowerPoint (Attachment 6a) should be presented.

Submitted August 16, 2016

Investigation Committee Members (alphabetical order)



David Hahn, Ph.D., Professor and Department Chair, Mechanical and Aerospace Engineering, UF



Mark Orazem, Ph.D., Distinguished Professor, Department of Chemical Engineering, UF



David Tanner, Ph.D., Professor, Department of Physics, UF