ONRG: INTERIM PROGRESS (FINAL) REPORT

Title: Analysis of real sonar type scatter data using the point cloud method.

Award number: N62909-18-1-2098

DUNS#: 588138677 CAGE Code: SGZ66 sam.gov: Funding Opportunity Number: N00014-17-S-B001 Relevant item within opportunity: Code 600, ONRG.

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1. Major Goals:

The major goal of the project was to improved on the pint cloud method presented in Palafox (2017): Palafox, A., M. Capistrán, and J. A. Christen (2017), "Point cloud-based scatterer approximation and affine invariant sampling in the inverse scattering problem", *Mathematical Methods in the Applied Sciences* **40**(9), 3393–3403.

The project proposed to explore new methodological improvements. Specifically, using real data and also advancing on non-convex shapes.

2. Accomplished:

The main contribution to improve on the point cloud methods is found in Daza-Torres, del Río, Capistrán, and Christen (2018). Computational geometric methods are used, using a non-convex alpha shape algorithm, to achieve a generalization of Palafox (2017).

Several other papers were published, using this project as partial support, namely Blaauw, Christen, and Aquino-López (2020); Capistrán and del Río (2020); Capistrán, Vinh, and Tuan (2020); Christen and Parker (2020); Parker, Christen, Lorenz, and Smith (2020). In section "Dissemination" we include the list of these published papers, including Daza-Torres et al. (2018).

3. Training:

The postdoscs Dr María Luisa Daza-Torres and Dr Luis Blanco-Cocom were partially supported by this project. Dr Daza-Torres finished her postdoc in August 2019 and Dr Blanco-Cocom will conclude his work in August this year.

4. Dissemination:

We cite here all published papers related to this grant (note that Daza-Torres et al. (2018) has not, as yet, been peer reviewed published; it is submitted). Moreover, offprints of these papers may be downloaded from: https://drive.google.com/drive/ folders/1jCF9H6J6Nz79DmwYYq_ikVLlhz9RLvF0?usp=sharing.

References

- Blaauw, M., J. A. Christen, and M. A. Aquino-López (2020). A review of statistics in palaeoenvironmental research. Journal of Agricultural, Biological and Environmental Statistics 25(1), 17–31.
- Capistrán, M. A. and J. A. I. del Río (2020). Estimating a pressure dependent thermal conductivity coefficient with applications in food technology. *Inverse Problems in Science and Engineering* 28(2), 277–293.
- Capistrán, M. A., P. C. Vinh, and T. T. Tuan (2020). Reliability assessment and data inversion using a surrogate model of wave propagation in functionally graded materials. *Inverse Problems in Science and Engineering* 28(5), 614–636.

- Christen, J. A. and A. E. Parker (2020). Systematic statistical analysis of microbial data from dilution series. *Journal of Agricultural, Biological and Environmental Statistics*.
- Daza-Torres, M. L., J. A. I. del Río, M. A. Capistrán, and J. A. Christen (2018). A computational geometry method for the inverse scattering problem.
- Parker, A., J. Christen, L. Lorenz, and H. Smith (2020). Optimal surface estimation and thresholding of confocal microscope images of biofilms using beer's law. *Journal* of Microbiological Methods 174, 105943.
- 5. Plans:

The project concluded in Abril 2020. An extension was granted due to the COVID19 situation. This allowed the PI to prepare this final report, since I am involved in research concerning the epidemic. However, the financial report is with a balance or 0 and no further activities are considered for this research grant.

6. Honors:

No formal honors are related to this project.

7. Technology Transfer:

No technological transfer. No DoD agency provided feedback (e.g. data).

- 8. Participants:
 - Dr J Andrés Christen (CIMAT-CONACYT), Principal Investigator-
 - Dr Marcos A. Capistrán (CIMAT-CONACYT), professor and main collaborator.
 - Dr Antonio Capella (IM-UNAM), professor and main collaborator.
 - Dr Maria Luisa Daza-Torres (formerly CIMAT-CONACYT, now at UG), postdoc under PI's supervision.
 - Dr Luis Blanco-Cocom (CIMAT-CONACYT), current postdoc under PI's supervision.
 - Mr José Cricelio Montesinos (CIMAT-CONACYT), PhD student under PI's supervision.
 - Mr Hugo Flores (CIMAT-CONACYT), PhD student under the supervision of dr Capistrán.