

**ACTIVITY REPORTING FORM**  
FOR CDC GRANTS PROGRAM  
IMU Simons African Fellowship Program

*(Deadline for completion: four (4) week after the end of the research visit)*

**Please note that at least four pictures of the supported activity should be included/ attached to this report.**  
(by email).

After consideration by CDC, the intention is that this activity report and pictures will be made publicly available on the CDC website.

Name of grantee: Ibrahim ADAMOU

Home institution and country of grantee: Université Dan Dicko Dankoulodo de Maradi , NIGER

Name of the host: Prof. Bernard MOURRAIN

Name of the host institution and country: INRIA, Sophia Antipolis (Nice), FRANCE

Topic of the research activity: Computing Voronoi Diagram of Parallel Half-lines in  $R^3$ .

Dates spend at the center/host institution: 2018-01-31 to 2018-03-29

The progress report should a brief (one page) activity report:

1. Summary statement (1-2 sentences) of major outcome of your visit:  
For this visit we consider the problem of computing Voronoi Diagram (VD) of a set of parallel half-lines, with the same orientation, constrained to a compact domain  $DO$  in  $R^3$ , with respect to the Euclidean distance. We have completed an implementation in Julia Language of the algorithm already designed for computing the topology of such VD, using a box subdivision process, which produces a mesh representing the topology of the VD in  $DO$ .
2. Brief description of your research activities during your research visit:  
The Voronoi Diagram (VD) is a one of the fundamental data structure in computational geometry with various applications in theoretical and practical areas. In three and higher dimension spaces VD is less studied, many basic problems are still open. The algorithm we designed (I. Adamou et al., 2014), consider the VD of parallel half-lines as Minimization Diagram of respective associated distances functions. By using criteria of topological regularity, the initial domain  $DO$  will be subdivided into subdomains following a kd-trees structure. All subdomains generating cells of the Voronoi diagram will be identified, and VD faces and VD edges are meshed inside from the *equidistant points*: of *two half-lines* on an edge of subdomain; of *three half-lines* on a face of a subdomain; and of *four half-lines* in a subdomain. An approximation of the VD cells which are topologically correct in  $DO$  will thus be determined. An implementation in Julia language with visualization using axel software of this algorithm are successful established.
3. Students and post-doctoral fellows advised: None  
I had several interesting discussions with some visiting researchers and doctoral students at INRIA.
4. Joint activities with your host:  
During my visit at INRIA, as scheduled, we started, with Prof. Bernard MOURRAIN our work on the computation of such VD. The work was conducted with a frequency of three up to four scheduled meetings per week. For this work we were able to complete an implementation in Julia Language for computing the topology of this VD. We firstly wrote, in Julia code (<https://github.com/ibradam/Voronoi.jl>), all necessary functions (*equidistant point from two half-lines* on an edge of a box, *equidistant point from three half-lines* on a face of a box, and *equidistant point from four half-lines* in a box), then *Regularity test*, *kd-tree Subdivision phase* and *Meshing process*. We finally proceeded to the experimentation of our algorithm and the visualization using the axel software.
5. Research in progress (as a result from the visit):  
We are analyzing of the practical complexity of the algorithm through the experimentation. In addition we are writing an article for publication.
6. Papers published or in preprint form as a result from the research visit:  
As a result of this research visit, we are writing an article entitled "*Computing the Topology of Voronoi Diagram of Parallel Half-lines in  $R^3$* " which will be submitted very soon to *the journal* for publication.
7. Planned future activities as a result of your research visit:  
In the following of our future research work, we propose to consider the case of line segments and curves of space  $R^3$  which may have important practical applications in industry and other scientific fields.

With my signature I agree that my Activity Report and pictures can be published on the CDC website.

Date: 2018-04-14

Signature Grantee:

