# Study Program in Japan in Details

Fayolle Pierre-Alain

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Firstly we want to remind to the reader the topic of the research (as it is stated in the paper *Field of Study*), which is the reconstruction of F-Rep from an unorganized set of points.

At the time, the possible research program in Japan would begin, some previous results should have already been acquired in the field of the integration and combination of Genetic Programing technics with F-Rep.
For instance, we should be able to perform Genetic Programing technics ( cross-over, mutation and eproduction ) to a F-Rep tree ( which defines a geometric model ) ; we should also have begun to work on the interactions between a modeler and the process of genetic evolution ( selection of model, introduction of new gene ).

These tools will be directly used and improved during my research in Japan to enhance the existing process of F-Rep reconstruction, such as the one described in [1], [2]. Genetic Programing and Algorithm will provide interesting features such as :

- The ability to reconstruct missing parts of geometric objects.
- The possibility to create new model on the base of existing ones.

Creating new model will help the modeler in the task of guessing the first function, hence minimizing the time of reconstruction, and enhancing the quality of the results.
Genetic Programming technics could also be used in the last stage of reconstruction to enhance the final result ( see also first point stated above ).
Then other way will be explored in order to obtain F-Rep reconstruction. Among these will be the study and use of Radial Basis Function combined with Neural Network for reconstruction of functionally based shapes.

A huge part of the research work will also consist in practical studies and « Real World » applications of the algorithms, as for instance the one did with the Haniwa statues in [2].
« Real World » tests will also lead us to experimentation in the combination of the different technics ( which do not seem to be exclusive ) and their impact on the results.
These results will have to feed different modeler's taste such as : does he want to do rapid prototyping ? Does he want to have accurate results ?

Finally, it is important to enumerate some possible different fields in which this study can be applied :

- Industrial Design : 3D scanning and F-Rep reconstruction could help in allowing the transfer from manually sculpture shapes into a CAD system.
- Historical Digitalisation and Restoration : 3D scanning will allow the preservation of old artefacts ( such as for example Haniwa statues stated in [2] ) from time destruction. It could also be possible to reconstruct some partially endammaged old models.
- Historical Simulation and Populating : once the models are digitalized it would become possible to use them as population and/or agents in historical simulation. This could find interests in schools, virtual museum, …
- Medical Vizualisation : Reconstruction from data acquired through a MRI scanner.

The three first point ( e.g Industrial Design, Historical Digitalisation and Historical Simulation insert in the work currently done by Professor Villbrandt and his team in the University of Aizu on the Aizu History Project ).

**References :**

1. V.V. Savchenko, A.A. Pasko, O.G. Okunev, T.L. Kunii, « Function Representation of Solids Reconstruction from Scattered Surface Points and Contours », Computer Graphics Forum, vol. 14, No. 4, 1995, pp. 181-188.
2. M.B.H. Shanat, P.A. Fayolle, B. Schmitt, T. Villbrandt, « Haniwa : A Case Study of Digital Visualization of Virtual Heritage Properties », EUROGRAPHICS UK, Leicester, UK, 2002 (to appear).
3. J.C. Carr, R.K. Beatson, T.J. Mitchell, W.R. Fright, B.C. McCallum, T.R. Evans, « Reconstruction and Representation 3D Objects with Radial Basis Functions », SIGGRAPH 2001, ACM, pp 67-76.