Program description

Programs used for implementing simplex style optimization algorithm for elasticity simulations in granular mechanics commercial software Itasca PFC [1]. Optimization is meant to find parameters used in previously developed anisotropy model that will reproduce elastic behavior of a given cubic material.

At the time of development, PFC did not have means of communicating with scripting languages except through socket communication. This polling communication scheme was developed to enable PFC simulations driven from MATLAB with mutual information exchange. MATLAB was chosen for it's well performing simplex optimization algorithm implementation `fminsearch`.

In the polling scheme shown in Figure 1 MATLAB and PFC communicate through a file `hold_flag.txt`. When the flag in the files is 0, PFC is running the simulation and MATLAB is on hold. While running, PFC saves stress/strain data into two files with specific formats. At the end, it changes the flag to 1, goes on hold, and MATLAB invokes another `fminsearch` iteration. In that process MATLAB uses the stress/strain data, deletes the files because they are being appended in every simulations, and computes new parameters to be tested with a PFC simulations. Finally, it changes the flag to 0 and the next simulation cycle begins. Once the error is sufficiently low, MATLAB terminates the optimization and changes the file name of `hold_flag.txt` to cause PFC to return with and error and thus interrupt the polling loop.

For purposes of my project this was an efficient scheme as the PFC simulations take a much larger time (3h or more) to complete than what is introduced by inefficiency of polling approach.

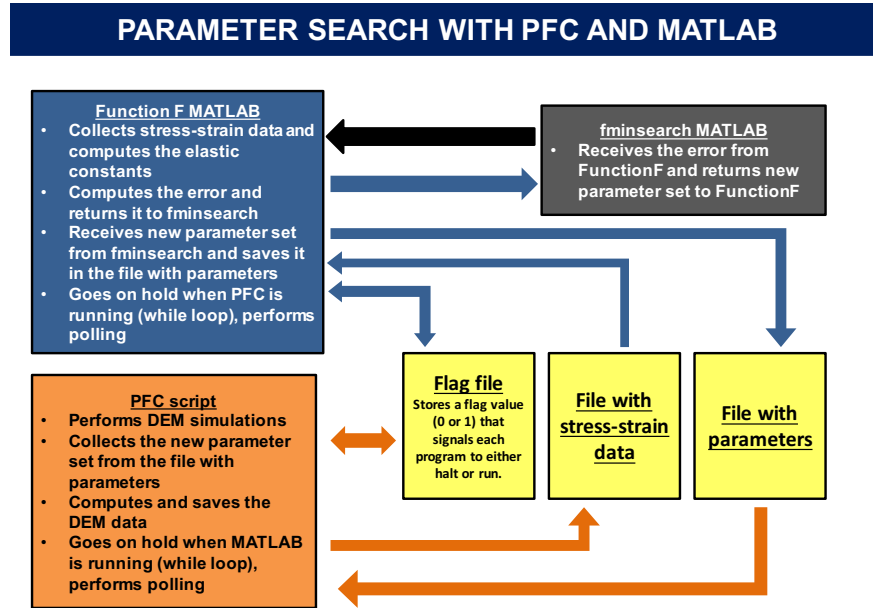This scheme has ever since been used as a template for many automated simulations in PFC.

Figure 1: Polling scheme for PFC-MATLAB communcation.

[1] http://www.itascacg.com/software/pfc