Development of Common Software Platform on Parallel Computations for Discretized Numerical Schemes

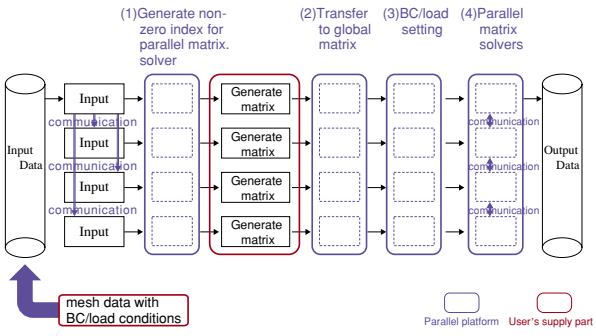
Akira TEZUKA
Research Institute for Computational Sciences
e-mail:
tezuka.akira@aist.go.jp
AIST Today Vol. 2, No. 8
(2002) 14

The Research Institute for Computational Science's Continuum Modeling Research Group at AIST and the Center for Computational Science and Engineering at FUJI Research Institute Corporation have developed a parallel software general platform for various numerical schemes such as finite element method, finite difference method, and finite volume method as well as other numerical schemes, to assist a smooth shift to parallel computational world for non-specialists in parallel computations, which only requires ordinary input data and the subroutine to construct his stiffness matrix. The source code and manual are released at the AIST website: http://www.aist.go.jp/infobase/pcp/index-en.html to general users with free of charge.

A major characteristic of this software platform is that it greatly assists users to parallelize his current numerical code in non-parallel computers with a high degree of parallel efficiency, regardless of any types of discretized numerical analysis technique used, and without advanced knowledge or experience in parallel computation required. Some parallel software such as PETSc, Aztec, GEOFEM, and ADVENTURE had been developed, however these are for professionals in parallel computations and not valid for the purpose above.

With this platform, users can enjoy large-scale, high-speed, parallel numerical computations in a few days, which may greatly activate computer-aided engineering (CAE) in industry. Because of severe competition in the worldwide business, most of the companies are trying to cut the cost in design section, by introducing commercial software developed mainly in the United States and Europe instead of original in-house numerical analysis software. However, "black box" use of commercial software results in the "death" of advanced technology in numerical simulation in this country, and too much dependency on imported software leads to lack of initiative on advanced fields and gives serious damages on industrial technology in Japan. By installing this platform to parallel computers, in-house numerical software can be easily enforced by parallel computations, and engineers can enjoy the advantages of vastly greater speed and scale in short developing time.

For the time being, more than 130 users enjoy parallel computations with our parallel platform. Both Japanese version and English version are available at the web site mentioned above. In near future, eigenvalue analysis matrix solvers and other functions will be added to meet further requirements from users. More demo programs are supposed to be added to this platform, hopefully by user's collaborations in part.



Data flow at parallel platform with 4CPUs

```
INCLUDE 'MPIF.H'                          : MPI include file
DIMENSION Aij(□), WORK(□), Bi(□), IDOMAIN(□)
CALL MPI_INIT(. . . )                     : MIP initialized
CALL MPI_COMM_RANK(. . . ,MYRANK,. . )    : Current processor
CALL MPI_COMM_SIZE(. . . , NPROC,. . )    : Number of processors
set IDOMAIN(I)                            : Partitioned data

CALL PCP_MKINDX                           : (1)Non-zero index gene.

DO  I=1,number of elements                : Stiff. matrix generation
    IF(IDOMAIN(I).EQ.MYRANK)THEN          : at each PE
      . . . . .
      Aij(□)=□                            : (User supplied part)

      CALL PCP_MKMATX                     : (2)Added to global mat.
    END IF
END DO

CALL PCP_MKBND0                           : (3)BC setting
CALL PCP_4FORCE                           : (3)Load setting

CALL PCP_IT4SLV(Aij,Bi,IDOMAIN,. . . ,WORK)  : (4)Parallel mat. solver

CALL MPI_FINALIZE(. . . )                 : MPI terminated
END
```

Modification pattern on FEM program