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#include "gridpack/include/gridpack.hpp"
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#include "pf_app.hpp"
```

```
#include "pf_factory.hpp"
```

```
// Calling program for powerflow application
```

Basic constructor

```
gridpack::powerflow::PFApp::PFApp(void)
{
}
```

Basic destructor

```
gridpack::powerflow::PFApp::~PFApp(void)
{
}
```

Enumerated type to distinguish between different configuration file formats. PSS/E version 23 and 33 formats are currently supported.

```
enum Parser{PTI23, PTI33};
```

Execute application. The name of XML-formatted input can be used as an argument to the executable

@param argc number of arguments

@param argv list of character strings

```

void gridpack::powerflow::PFApp::execute(int argc, char** argv)
{
    // Define a communicator on the group of all processors (the world group)
    // and create an instance of a power flow network
    gridpack::parallel::Communicator world;
    boost::shared_ptr<PFNetwork> network(new PFNetwork(world));

    // Read configuration file. If file is not specified when invoking the
    // executable, assume the input file is called "input.xml"
    gridpack::utility::Configuration *config
        = gridpack::utility::Configuration::configuration();
    // Echo input file to standard out
    config->enableLogging(&std::cout);
    bool opened;
    if (argc >= 2 && argv[1] != NULL) {
        char inputfile[256];
        sprintf(inputfile,"%s",argv[1]);
        opened = config->open(inputfile,world);
    } else {
        opened = config->open("input.xml",world);
    }
    // If no input file found, return
    if (!opened) return;

    // Find the Configuration.Powerflow block within the input file
    // and set cursor pointer to that block
    gridpack::utility::Configuration::CursorPtr cursor;
    cursor = config->getCursor("Configuration.Powerflow");
    std::string filename;
    int filetype = PTI23;
    // If networkConfiguration field found in input, assume that file
    // is PSS/E version 23 format, otherwise if networkConfiguration_v33
    // field found in input, assume file is version 33 format. If neither
    // field is found, then no configuration file is specified so return
    if (!cursor->get("networkConfiguration",&filename)) {
        if (cursor->get("networkConfiguration_v33",&filename)) {
            filetype = PTI33;
        } else {

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    printf("No network configuration file specified\n");
    return;
}
}
// Set convergence and iteration parameters from input file. If
// tolerance and maxIteration fields not found, then use defaults
double tolerance = cursor->get("tolerance",1.0e-6);
int max_iteration = cursor->get("maxIteration",50);
ComplexType tol;
// Different files use different conventions for the phase shift sign.
// Allow users to change sign to correspond to the convention used
// in this application.
double phaseShiftSign = cursor->get("phaseShiftSign",1.0);

// Echo network file name to standard out and create appropriate parser.
// Parse the file and change the phase shift sign, if necessary. The
// rank() function on the communicator is used to determine the processor ID
if (world.rank() == 0) printf("Network filename: (%s)\n",filename.c_str());
if (filetype == PTI23) {
    if (world.rank() == 0) printf("Using V23 parser\n");
    gridpack::parser::PTI23_parser<PFNetwork> parser(network);
    parser.parse(filename.c_str());
    if (phaseShiftSign == -1.0) {
        parser.changePhaseShiftSign();
    }
} else if (filetype == PTI33) {
    if (world.rank() == 0) printf("Using V33 parser\n");
    gridpack::parser::PTI33_parser<PFNetwork> parser(network);
    parser.parse(filename.c_str());
    if (phaseShiftSign == -1.0) {
        parser.changePhaseShiftSign();
    }
}
}

// Partition network between processors
network->partition();

// Echo number of buses and branches to standard out. This message prints from

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```

// each processor. These numbers may be different for different processors
printf("Process: %d NBUS: %d NBRANCH: %d\n",world.rank(),network->numBuses(),
      network->numBranches());

// Create serial IO object to export data from buses
gridpack::serial_io::SerialBusIO<PFNetwork> busIO(8192,network);
char ioBuf[128];

// Echo convergence parameters to standard out. The use of the header
// method in the SerialBusIO class guarantees that the message is only
// written once to standard out.
sprintf(ioBuf,"\nMaximum number of iterations: %d\n",max_iteration);
busIO.header(ioBuf);
sprintf(ioBuf,"\nConvergence tolerance: %f\n",tolerance);
busIO.header(ioBuf);

// Create factory and call the load method to initialize network components
// from information in configuration file
gridpack::powerflow::PFFactory factory(network);
factory.load();

// Set network components using factory. This includes defining internal
// indices that are used in data exchanges and to manage IO
factory.setComponents();

// Set up bus data exchange buffers. The data to be exchanged is defined
// in the network component classes
factory.setExchange();

// Create bus data exchange. Data exchanges between branches are not needed
// for this calculation
network->initBusUpdate();

// Create components Y-matrix
factory.setYBus();

// Create components of S vector and print out first iteration count
// to standard output

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factory.setSBus();
busIO.header("\nIteration 0\n");

factory.setMode(RHS);
gridpack::mapper::BusVectorMap<PFNetwork> vMap(network);
boost::shared_ptr<gridpack::math::Vector> PQ = vMap.mapToVector();
// Create Jacobian matrix
factory.setMode(Jacobian);
gridpack::mapper::FullMatrixMap<PFNetwork> jMap(network);
boost::shared_ptr<gridpack::math::Matrix> J = jMap.mapToMatrix();

// Create X (solution) vector by cloning PQ
boost::shared_ptr<gridpack::math::Vector> X(PQ->clone());

```

The `LinearSolver` object solves equations of the form $\bar{A} \cdot \bar{X} = \bar{B}$

```

// Create linear solver and configure it with settings from the
// input file (inside the LinearSolver block)
gridpack::math::LinearSolver solver(*J);
solver.configure(cursor);

// Set initial value of the tolerance
tol = 2.0*tolerance;
int iter = 0;

// First iteration of the solver to initialize Newton-Raphson loop
X->zero(); //might not need to do this
busIO.header("\nCalling solver\n");
solver.solve(*PQ, *X);

```

`normInfinity` evaluates the norm $N = \sum_i |X_i|$

```

// The Newton-Raphson algorithm evaluates incremental changes to the solution
// vector. When the algorithm is done, the RHS vector is zero
tol = PQ->normInfinity();

```

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while (real(tol) > tolerance && iter < max_iteration) {

```

```

// Push current values in X vector back into network components
// This uses setValues method in PFBus class in order to work
factory.setMode(RHS);
vMap.mapToBus(X);

// Exchange data between ghost buses (We don't need to exchange data
// between branches)
network->updateBuses();

// Update Jacobian and PQ vector with new values
vMap.mapToVector(PQ);
factory.setMode(Jacobian);
jMap.mapToMatrix(J);

// Resolve equations (the solver can be reused since the number and
// location of non-zero elements is the same)
X->zero(); //might not need to do this
solver.solve(*PQ, *X);

// Evaluate norm of residual and print out current iteration to standard
// out
tol = PQ->normInfinity();
sprintf(ioBuf, "\nIteration %d Tol: %12.6e\n", iter+1, real(tol));
busIO.header(ioBuf);
iter++;
}

// Push final result back onto buses so we get the right values printed out to
// output
factory.setMode(RHS);
vMap.mapToBus(X);

// Make sure that ghost buses have up-to-date values before printing out
// final results (evaluating power flow on branches requires correct values
// of voltages on all buses)
network->updateBuses();

// Write out headers and power flow values for all branches

```

```

gridpack::serial_io::SerialBranchIO<PFNetwork> branchIO(512,network);
branchIO.header("\n  Branch Power Flow\n");
branchIO.header("\n          Bus 1          Bus 2   CKT          P"
                "\n                                Q\n");
// Write branch values
branchIO.write();

// Write out headers and voltage values for all buses
busIO.header("\n  Bus Voltages and Phase Angles\n");
busIO.header("\n  Bus Number          Phase Angle          Voltage Magnitude\
n");
// Write bus values values
busIO.write();
}

```