MANITOBA HYDRO INTERNATIONAL &
THE UNIVERSITY OF WINNIPEG

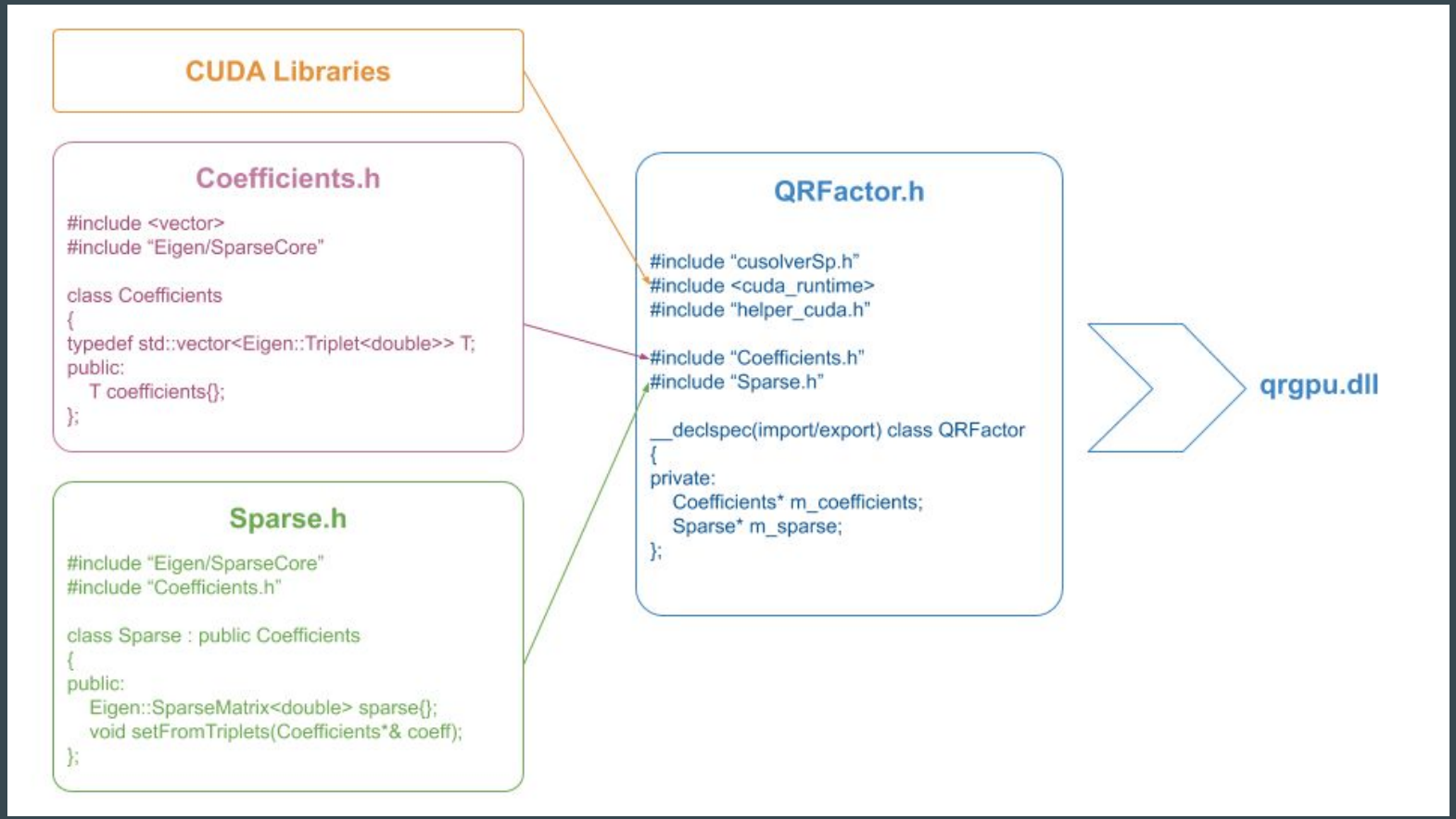
GPU SOLUTIONS FOR PSCAD

PROJECT UPDATE

- Separated existing code into classes and functions that could be called by a separate program
- Wrote methods to assemble the full system matrix out of multiple dense subsystems by making use of existing Eigen library
- Tested and verified this version of QRFactor with several small input matrices against host-only methods
- Added detailed documentation

PROJECT UPDATE

- Constructed a Dynamic-Link Library (DLL) for QRFactor using VS2019
- Sparse matrix construction methods rely on Eigen package, which contain derived data types, and so cannot be part of the exported class in the DLL
- Create handle classes and include pointers to the classes in the main part of the DLL
- Operate on derived data types in handle classes
- CUDA libraries come built this way, so integration into main DLL class did not create issues
- Need to start with CUDA Console app template in VS2019 (for CUDA library linkages and nvcc compiler) and change output type to DLL


CUDA Libraries
Coefficients.h
#include <vector>
#include "Eigen/SparseCore"
class Coefficients
{
typedef std::vector<Eigen::Triplet<double>> T;
public:
T coefficients{};
};
Sparse.h
#include "Eigen/SparseCore"
#include "Coefficients.h"
class Sparse : public Coefficients
{
public:
Eigen::SparseMatrix<double> sparse{};
void setFromTriplets(Coefficients*& coeff);
};
QRFactor.h
#include "cusolverSp.h"
#include <cuda_runtime>
#include "helper_cuda.h"
#include "Coefficients.h"
#include "Sparse.h"
__declspec(import/export) class QRFactor
{
private:
Coefficients* m_coefficients;
Sparse* m_sparse;
};
qrgpu.dll

IMPLEMENTATION

- Step-by-step instructions on creating and implementing a custom library within VS2019 can be found in the Microsoft Documentation
- Again, start with CUDA Console app template (CUDA libraries and nvcc compiler)
- #include qrgpu.h
- Add as additional library with library directory in project settings
- Add post-build event to copy qrgpu.dll to project output directory
- Use as a normal library

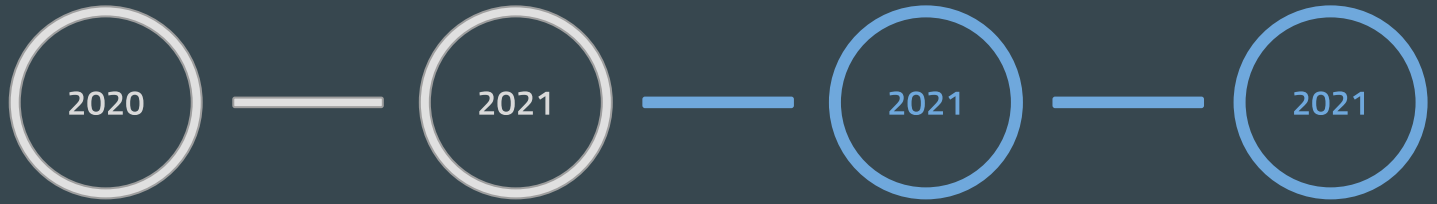
NEXT STEPS

- Benchmarking with qrgpu.lib
- Using library in PSCAD?

NEAR FUTURE

- Regular meetings with MHI member/team?
- Second half of postdoc position

PROPOSED 2020/2021 SCHEDULE



December

Working full time for MHI

January - February

Working full time for MHI, starting to work with Kraków

March - August

Working full time with Kraków, part time for MHI

Original end of 1 year, full time postdoc

September - February

Working full time with Kraków, continue part time for MHI

Extension of original timeline by 6 months