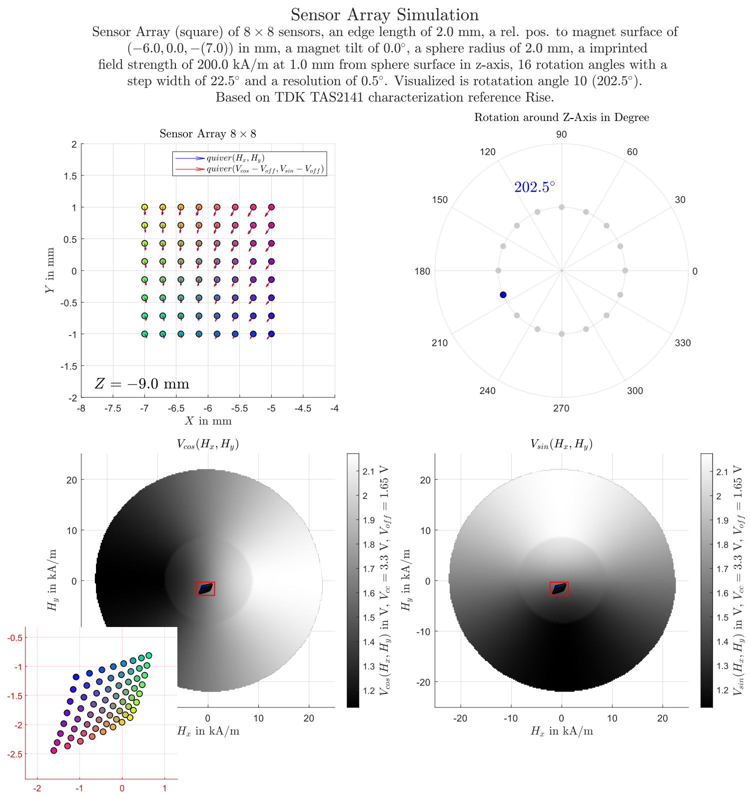
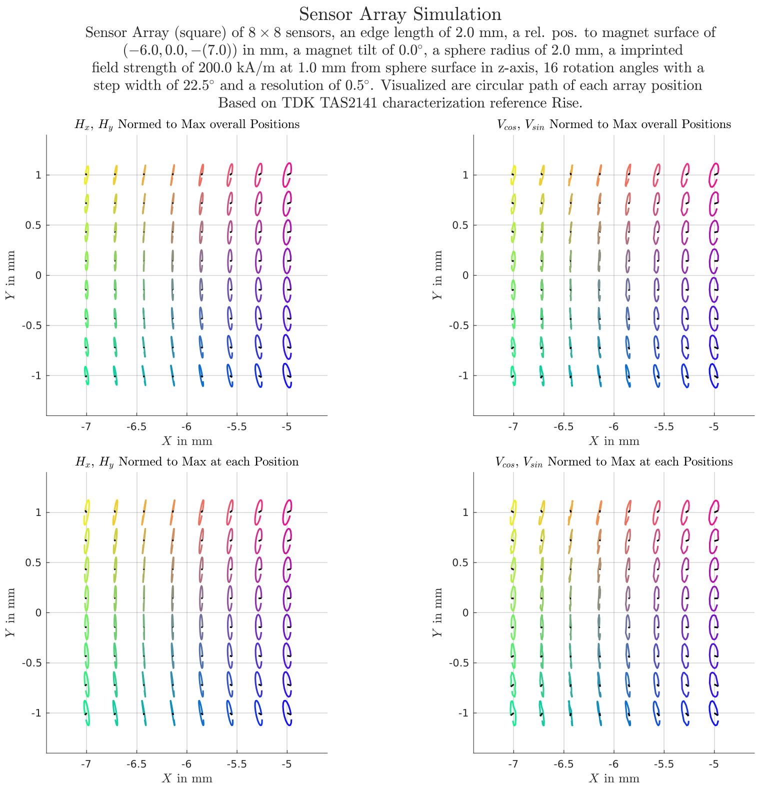
Training and Test Datasets

Training and test datasets are generated by sensor array simualtion part of the software. One dataset contains the simulation results generated with current configuration of used magnet in simulation and a setup of position and sensor behavior. The simulation computes for configured angles with certain angle resultion the magnetic field strength at sensor array member position for a rotation of the magnet through the configured angles. With respect to positions and angles the simulation maps the field strength for each array member to specified characterization field (current TDK Rise) and interpolates (nearest neighbor) the sensor bridge output voltages for cosinus and sinus bridge for each sensor array member. The aquirred data is save in matrices with same orientation as sensor array member matrice or corrodinate matrices of the sensor array, so it completes the rotation in related data matrices.



Above image shows the 10th rotation angle of a rotation with 16 even distributed angles between 0° and 360°.



Here a visualization of the full rotation at once with colored position related to the simulation plot of single simulation angle. The circular path are the path in in characterization field.

Training and test datasets filenames are build by a certain pattern.

[Training|Test]_YYYY-mm-dd-_HH-MM-SS-FFF.mat

They are saved under data path data/training and data/test.

A best practice can been seen in workflow topic of the documentation.

Contents

Dataset Structure

Info:

A training ot test dataset is parted into two main structures the first one the Info struct contains information about the simulation configuration and setup in which the simulation constructed the dataset.

- **SensorArrayOptions** - struct, contains setting of sensor size and behavior
- **DipoleOptions** - struct, contains setting of used magnet which was used in the simulation
- **UseOptions** - struct, contains information about use of the dataset if it is constructed for training or test use, sensor array position, number of angles, tilt of manget and so on.
- CharData - string, identifies the characteriazation data set which was used to simulate the array members.
- **Units** - struct, si units of data in datasets
- filePath - string, which points on the absolute path origin where the dataset was saved including filename.

- **SensorOptions:**

- geometry - char, indentifier string of which shape the sensor array geometry was constructed, geometry of used meshgrid in computation
- dimension - double, number of sensors at one array edge for square geometry
- edge - double, edge lenght in mm of senseor array
- Vcc - double, supply voltage of the sensor array
- Voff - double, bridge offset voltage off the sensor array
- Vnorm - double, norm value to get voltage values from characterization fields in combination with Vcc and Voff, TDK dataset is normed in mV/V.
- SensorCount, double - number of sensors in the sensor array for square geometry it is square or dimension

- **DipoleOptions:**

- sphereRadius - double, radius in mm around dipole magnet to approximate a spherical magnet in simulation with far field approximation (dipole field equation)
- H0mag - double, field strenght magnitude in kA/m which is imprinted on the compute field strength of the use magnet in a certain distance from magnet surface to consturct magnet with fitting characteristics for simualtion.
- z0 - double, distance from surface in which H0mag is imprinted on field computed field strength of the use magnet. Imprinting respects magnet tilts so the distance is always set to the magnet z-axis with no shifts in x and y direction
- M0mag - double, magnetic dipole moment magnitude which is used to define the magnetization direction of the magnet in tis rest position.

- **UseOptions:**

- useCase - string, identifies the dataset if it is for training or test purpose
- xPos - double, relative sensor array position to magnet surface
- yPos - double, relative sensor array position to magnet surface
- zPos - double, relative sensor array position to magnet surface
- tilt - double, magnet tilt in z-axis
- angleRes - double, angle resolution of rotation angles in simulation
- phaseIndex - double, start phase of rotation as index of full scale rotation angles with angleRes
- nAngles - double, number of rotation angles in datasets
- BaseReference - char, identifier which characterization dataset was loaded
- BridgeReference - char, identifier which reference from characteriazation dataset was used to generate cosinus and sinus voltages

- **Units:**

- SensorOutputVoltage - char, si unit of sensor bridge outputs
- MagneticFieldStrength - char, si unit of magnetic field strength
- Angles - char, si unit of angles
- Length - char, si unit of metric length

Data:

- HxScale - 1 x L double vector of Hx field strength amplitudes used in charcteriztion to construct sensor characterization references, x scale for characterization reference
- HyScale - 1 x L double vector of Hy field strength amplitudes used in charcteriztion to construct sensor characterization references, y scale for characterization reference
- VcosRef - L x L double matrix of cosinuns bridge characterization field corresponding to HxScale and HyScale
- VsinRef - L x L double matrix of sinuns bridge characterization field corresponding to HxScale and HyScale
- Gain - double, scalar gain factor for bridge outputs (interanl amplification)
- r0 - 3 x 1 double vector of magnet rest position from magnet surface and respect to magnet magnet tilt, used in computation of H0norm to imprint a certain field strength on magnets H-field, respects

sphere radius of magnet

- m0 - 3 x 1 vector of magnetic dipole moment in magnet rest position with respect of manget tilt, used to compute H0norm to imprint a certain field strength on magnet H-field, the magnitude of this vector is equal to M0mag
- H0norm - double, scalar factor to imprint a certain field strength on magnet H-field in rest position with respect to magnet tilt in coordinate system
- m - 3 x M double vector of magnetic dipole rotation moments each 3 x 1 vector is related to i-th rotation angle
- angles - 1 x M double vector of i-th rotation angles in degree
- angleStep - double, scalar of angle step width in rotation
- angleRefIndex - 1 x M double vector of indices which refer to a full scale rotation of configure angle resuolution, so it abstracts a subset angle rotation to the same rotation with all angles given by angle resolution
- X - N x N double matrix of x coordinate positions of each sensor array member
- Y - N x N double matrix of y coordinate positions of each sensor array member
- Z - N x N double matrix of z coordinate positions of each sensor array member
- Hx - N x N x M double matrix of compute Hx-field strength at each sensor array member position for each rotation angle 1...M
- Hy - N x N x M double matrix of compute Hy-field strength at each sensor array member position for each rotation angle 1...M
- Hz - N x N x M double matrix of compute Hz-field strength at each sensor array member position for each rotation angle 1...M
- Habs - N x N x M double matrix of compute H-field strength magnitude at each sensor array member position for each rotation angle 1...M
- Vcos - N x N x M double matrix of computed cosinus bridge outputs at each sensor array member position for each rotation angle 1...M
- Vsin - N x N x M double matrix of computed sinus bridge outputs at each sensor array member position for each rotation angle 1...M

See Also

- Simulation Workflow
- sensorArraySimulation
- simulateDipoleSensorArraySquareGrid
- generateSimulationDatasets
- generateConfigMat