README file for Myers, et al. *Plasma Phys. Controlled Fusion* paper titled, "Quasi-static and dynamic magnetic tension forces in arched, line-tied magnetic flux ropes."

Each figure has an accompanying PDF of the figure itself and an HDF5 file of the archived figure data. The contents of each HDF5 file are described below.

Normalization factors used throughout:

- τ_A = 3.2 μs
- x_f = 18 cm

Figure 1: Sample *in situ* magnetic field measurements

- panel_a
  - shot_number = MRX shot number for the data in this panel [Shot 153992]
  - annotation_data
    - electrode[1,2]_[x,z]vec = *x*,*z* points for electrode 1,2 annotations [cm]
    - probe_pts_[x,z]vec = *x*,*z* locations of the magnetic field measurements [cm]
    - vessel_wall_[x,z]vec = *x*,*z* profile of the vacuum vessel wall [cm]
    - shifted_circle_[x,z]vec = *x*,*z* profile of the shifted-circle approximation for the magnetic axis [cm]
  - color_data
    - [x,z]grid = *x*,*z* grid on which the color data are plotted [cm]
    - BP_data = poloidal magnetic field data [G]
  - vector_data
    - [x,z]grid = *x*,*z* grid on which the vector data are plotted [cm]
    - BTi_v[x,z] = *x*,*z* vector components of the internal toroidal magnetic field [G]
  - magax_data
    - contour_[x,z]grid = *x*,*z* grid on which the magnetic axis is computed [cm]
    - contour_BP_data = out-of-plane poloidal magnetic field data for computing the magnetic axis [G]
    - contour_level = B_P contour level for computing the magnetic axis [G]
- panel_b
  - shot_number = MRX shot number for the data in this panel [Shot 154288]
  - annotation_data = identical to Fig. 3, panel (d)
  - color_data
    - [y,z]grid = *y*,*z* grid on which the color data are plotted [cm]
    - BTi_data = internal toroidal magnetic field data [G]
  - vector_data
    - [y,z]grid = *y*,*z* grid on which the vector data are plotted [cm]
    - BP_v[y,z] = *y*,*z* vector components of the poloidal magnetic field [G]
  - magax_data
    - magax_[y,z]val = spatial point where the magnetic axis is located [cm]

Figure 2: Height-time plots from four representative flux rope discharges

- panel_a
  - time = time vector for this panel [normalized to τ_A]
  - IT_mean = mean plasma current waveform [kA]

- IT_stddev = standard deviation of the plasma current waveform [kA]
- panel_b, subpanel_[1,2,3,4]
  - shot_number = MRX shot number for the data in this panel
  - color_data
    - tgrid = time grid on which the color data are plotted [normalized to τ_A]
    - zgrid = z grid on which the color data are plotted [normalized to x_f]
    - By_data = out-of-plane magnetic field data [G]
  - contour_data
    - time_vec = time vector for the z_{apex} contours [normalized to τ_A]
    - zapex_vec = height vector for the z_{apex} contours [normalized to x_f]
    - time_vec_avg = time vector for the $\langle z_{apex} \rangle$ contours [normalized to τ_A]
    - zapex_vec_avg = height vector for the $\langle z_{apex} \rangle$ contours [normalized to x_f]
    - NaN values are inserted to separate individual contour segments

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Figure 3: The experimentally measured torus versus kink instability parameter space

- qa_vec = vector of ensemble-averaged edge safety factor, q_a [dimensionless]
- n_vec = vector of ensemble-averaged field decay index, n [dimensionless]
- dz_vec = vector of ensemble-averaged instability amplitude, $\langle \delta z \rangle / x_f$ [normalized to x_f]
- qa_thresh = empirically identified kink instability threshold window [dimensionless]
- n_thresh = empirically identified torus instability threshold window [dimensionless]

Figure 4: Sample force measurements

- analytical_forces:
  - [hoop, strapping, tension]:
    - xdata_time = time vector for the analytically computed [hoop, strapping, tension] force [μs]
    - ydata_force = data vector for the analytically computed [hoop, strapping, tension] force [normalized to $F_{norm} = \mu_0 I_T / 4\pi x_f$]
- measured_forces:
  - [hoop, strapping, tension, net]:
    - xdata_time = time vector for the measured [hoop, strapping, tension, net] force [μs]
    - ydata_force = data vector for the measured [hoop, strapping, tension, net] force [normalized to $F_{norm} = \mu_0 I_T / 4\pi x_f$]
- annotations:
  - dynamic_tension = scalar value of the dynamic tension force [$F_{norm} = \mu_0 I_T / 4\pi x_f$]
  - quasi_static_hoop = scalar value of the quasi-static hoop force [F_{norm}]
  - quasi_static_strapping = scalar value of the quasi-static strapping force [F_{norm}]
  - quasi_static_tension = scalar value of the quasi-static tension force [F_{norm}]
  - time[1,2] = beginning [1] and end [2] of the force averaging time window [μs]

Figure 5: Measured vs. predicted forces

- [hoop, strapping, tension]_force
  - xdata_predicted = analytically predicted [hoop, strapping, tension] force data points [$F_{norm} = \mu_0 I_T / 4\pi x_f$]
  - ydata_measured = measured [hoop, strapping, tension] force data points [F_{norm}]

- net_force
  - xdata_predicted = database-averaged net force (predicted) [F_{norm}]
  - ydata_measured = database-averaged net force (measured) [F_{norm}]
  - xdata_predicted_error = error bar on net force (predicted) [F_{norm}]
  - ydata_measured_error = error bar on net force (measured) [F_{norm}]

Figure 6: Parameter dependence of the dynamic toroidal field tension force

- data_points_w_force (points where force measurements *can* be obtained):
  - xdata_qa = vector of ensemble-averaged edge safety factor, q_{a} [dimensionless]
  - ydata_n = vector of ensemble-averaged field decay index, n [dimensionless]
  - zdata_dFt_fraction = dynamic tension fraction [dimensionless]
- data_points_w_force (points where force measurements *cannot* be obtained):
  - xdata_qa = vector of ensemble-averaged edge safety factor, q_{a} [dimensionless]
  - ydata_n = vector of ensemble-averaged field decay index, n [dimensionless]
- thresholds:
  - xthresh_qa = empirically identified kink instability threshold window [dimensionless]
  - ythresh_n = empirically identified torus instability threshold window [dimensionless]

Figure 7: Magnetic analysis of a characteristic failed torus event

- shot_number = MRX shot number for the data in this figure [Shot 154410]
- panel_a:
  - time_vec_failed = time vector for this panel [normalized to τ_{A}]
  - height_vec_failed = height vector for the failed flux rope evolution [normalized to x_{f}]
  - time_pts = the four time points evaluated in (d), (e) [normalized to τ_{A}]
- panel_b:
  - time_vec = time vector for this panel [normalized to τ_{A}]
  - flux_pol_vec = vector of poloidal flux as a function of time [mWb]
  - flux_tor_vec = vector of toroidal flux as a function of time [mWb]
  - time_pts = the four time points evaluated in (d), (e) [normalized to τ_{A}]
- panel_c:
  - time_vec = time vector for this panel [normalized to τ_{A}]
  - Fh_vec = vector of the hoop force as a function of time [N/m]
  - Fs_vec = vector of the strapping force as a function of time [N/m]
  - FT_plus_Fs_vec = vector of the toroidal field forces plus the strapping force as a function of time [N/m]
  - time_pts = the four time points evaluated in (d), (e) [normalized to τ_{A}]
- panel_d, subpanels_[1,2,3,4]
  - annotation_data
    - electrode_[y,z]vec = *y*,*z* points for the electrode annotation [cm]
    - probe_pts_[y,z]vec = y,*z* locations of the magnetic field measurements [cm]
    - vessel_wall_[y,z]vec = y,*z* profile of the vacuum vessel wall [cm]
  - color_data
    - [y,z]grid = *y*,*z* grid on which the color data are plotted [cm]
    - JT_data = toroidal current density data [$\mathrm{MA \cdot m^{-2}}$]
  - vector_data

        - [y,z]grid = *y,z* grid on which the vector data are plotted [cm]
        - BP_v[y,z] = *y,z* vector components of the poloidal magnetic field [G]
- panel_e, subpanels_[1,2,3,4]
    - annotation_data = identical to panel_d
    - color_data
        - [y,z]grid = *y,z* grid on which the color data are plotted [cm]
        - BTi_data = internal (plasma produced) toroidal magnetic field data [G]
