COILOPT Progress and Plans

D. Strickler, S. Hirshman, L. Berry

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Coilopt progress and plans

- Coil representation
- Multifilament model
- Stellopt/Coilopt merger
- Coilopt tasks and plans

Coil representation

Previous: $v(u) = \Sigma\, a_k \cos(2\pi k u) + b_k \sin(2\pi k u)$

New: $u(s) = \alpha s + \Sigma\, a^u_k \cos(2\pi k s) + b^u_k \sin(2\pi k s)$

$v(s) = \beta s + \Sigma\, a^v_k \cos(2\pi k s) + b^v_k \sin(2\pi k s)$

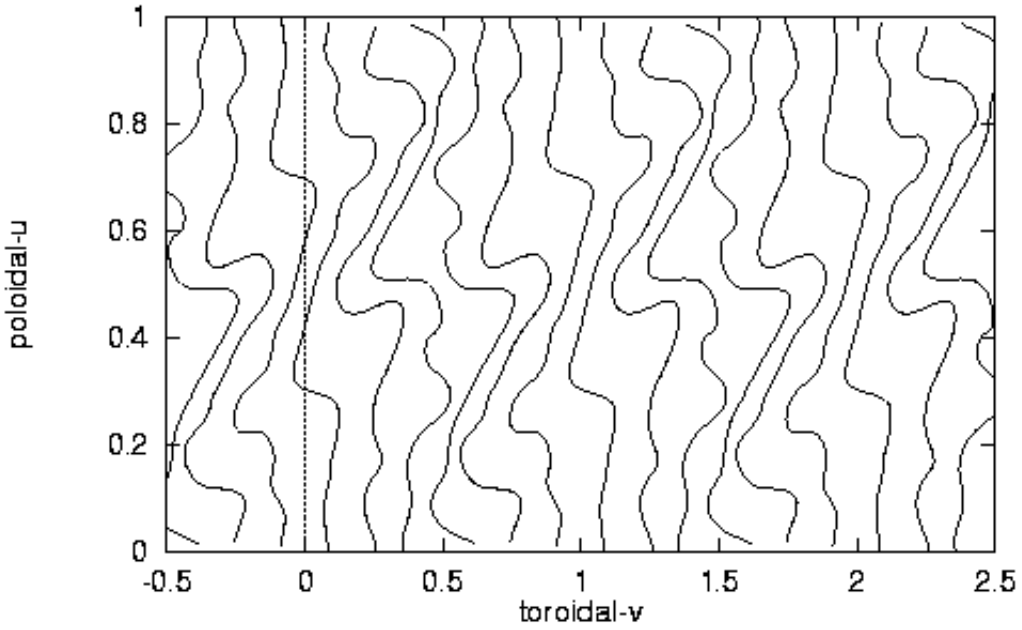
$0 \le s \le 1$

$(\alpha, \beta) =$

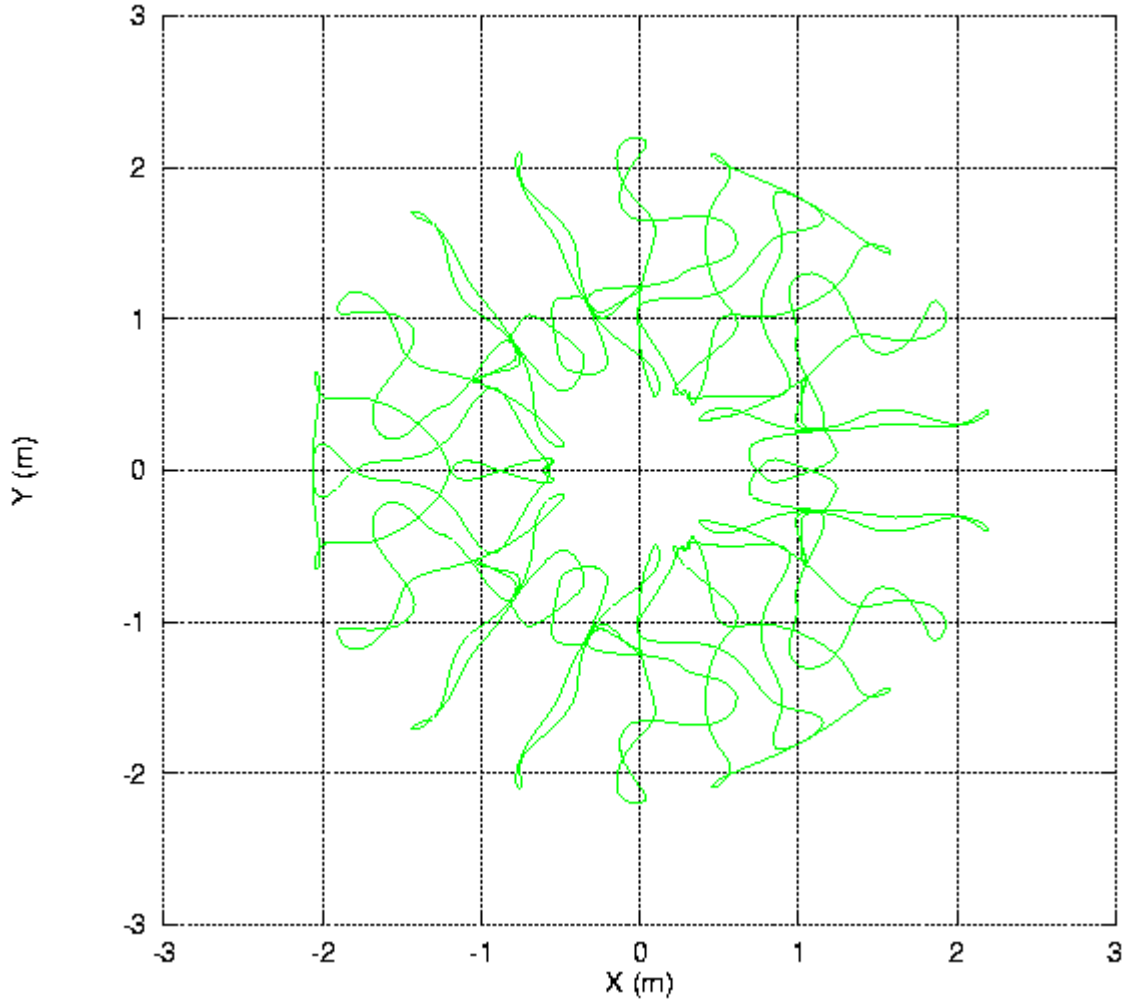
- (0, 0) - saddle
- (1, 0) - modular
- (0, 1) - wavy PF
- (1, 1) - helical

New coil representation

Additional flexibility allows ‘windbacks’ for modular coils



Modular example – new coil representation

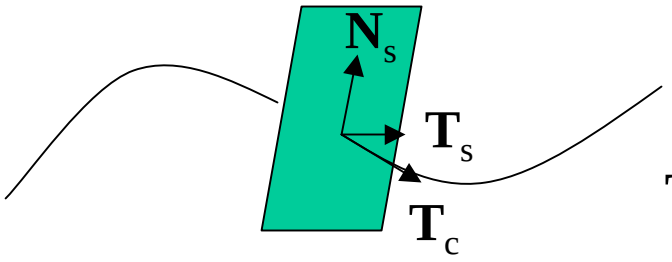


- $\langle R \rangle$ = 1.4 m (li383)
- 6 coils per field period
- No ‘symmetry coils’
- 3 coil types
- $\delta B_{avg} < 0.9\%$
- $\Delta_{cc,min}$ = 12.2 cm
- ρ_{min} = 10.8 cm
- $\Delta_{cp,min}$ = 20.4 cm

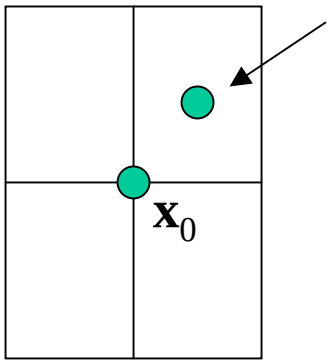
Status of new coil representation

- Implemented and tested for modular, saddle coils
- Coil separation, radius of curvature constraints
- No option for ‘symmetry coils’

Multifilament model

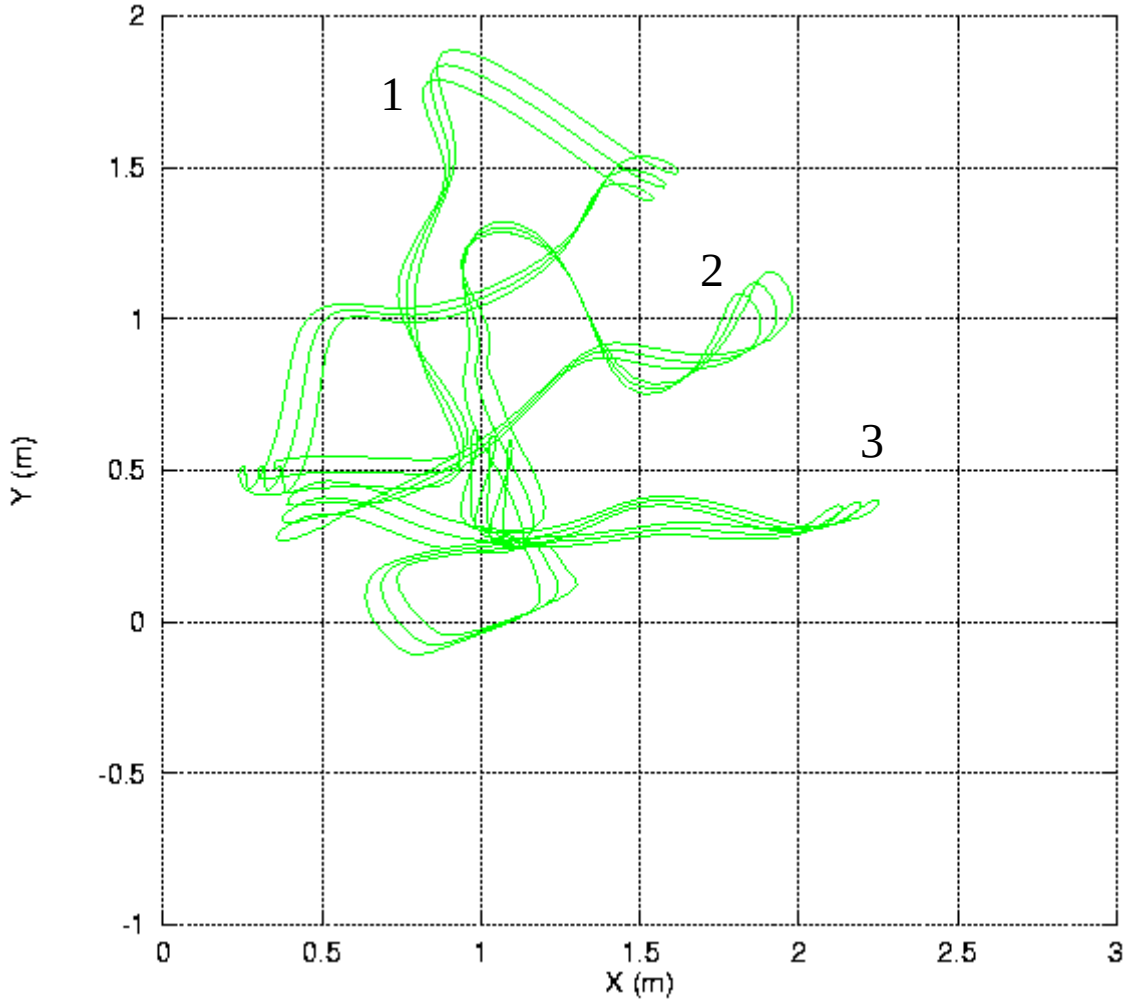


$$\mathbf{T}_s = \mathbf{N}_s \times \mathbf{T}_c$$



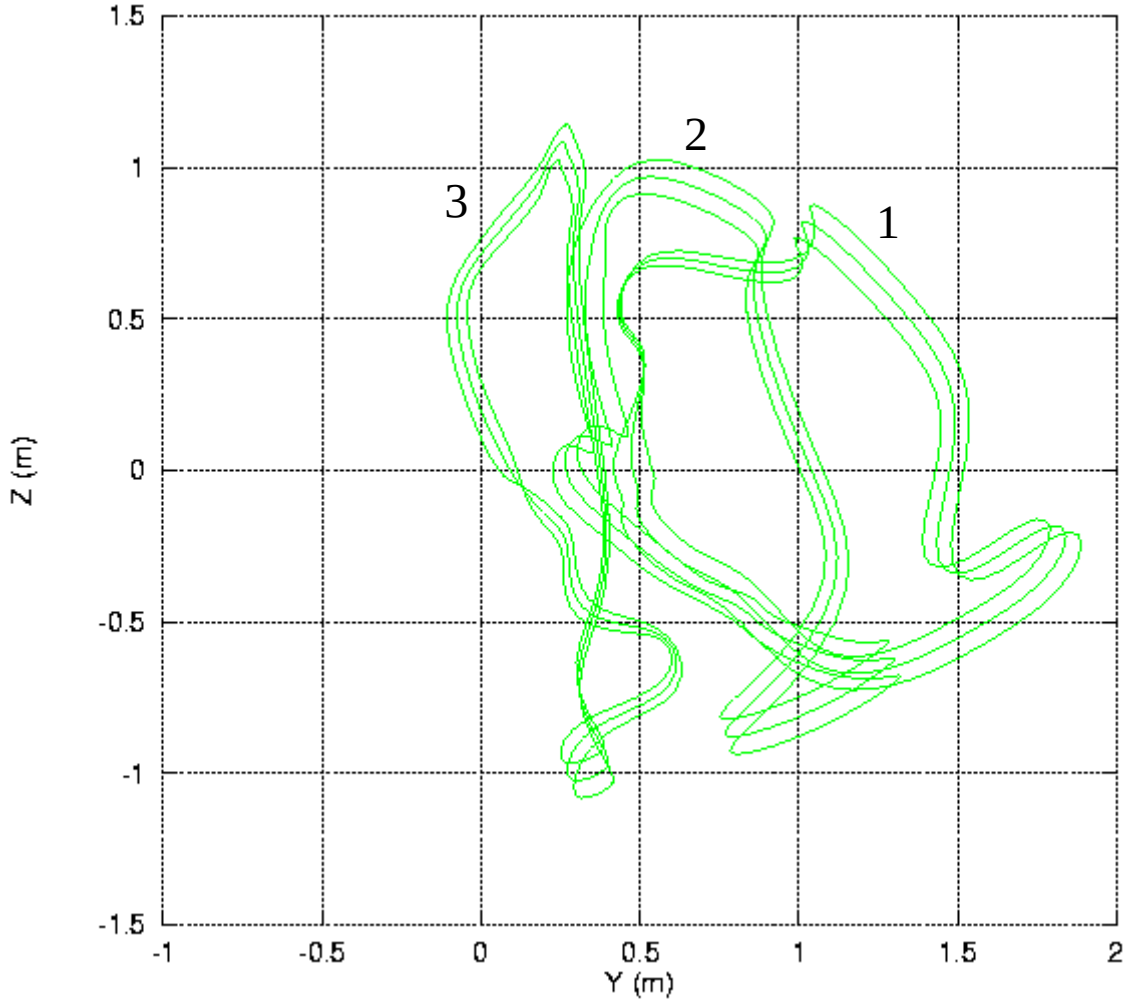
$$\mathbf{x} = \mathbf{x}_0 + h\mathbf{N}_s + w\mathbf{T}_s$$

Three filament model – top view



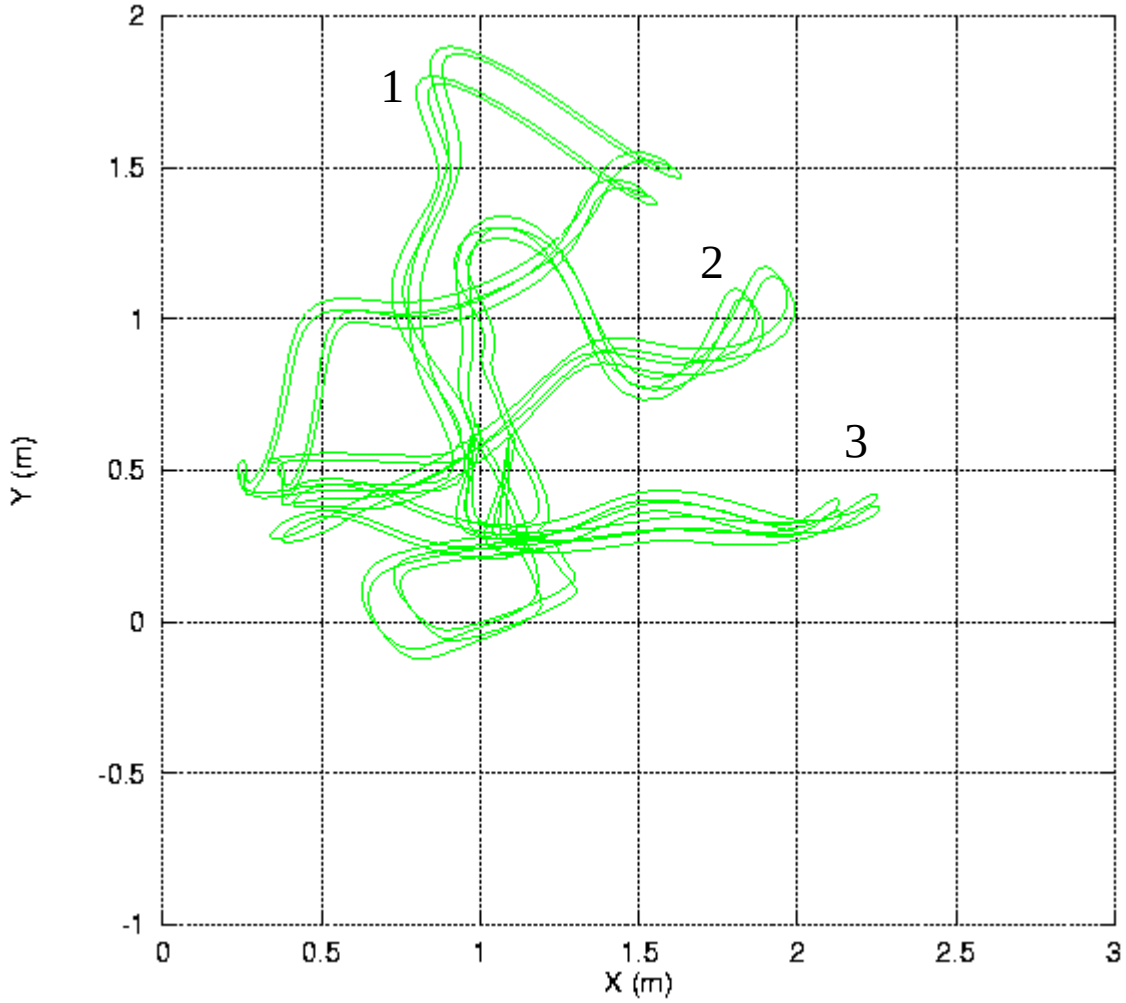
h = ± 6 cm

Three filament model – side view



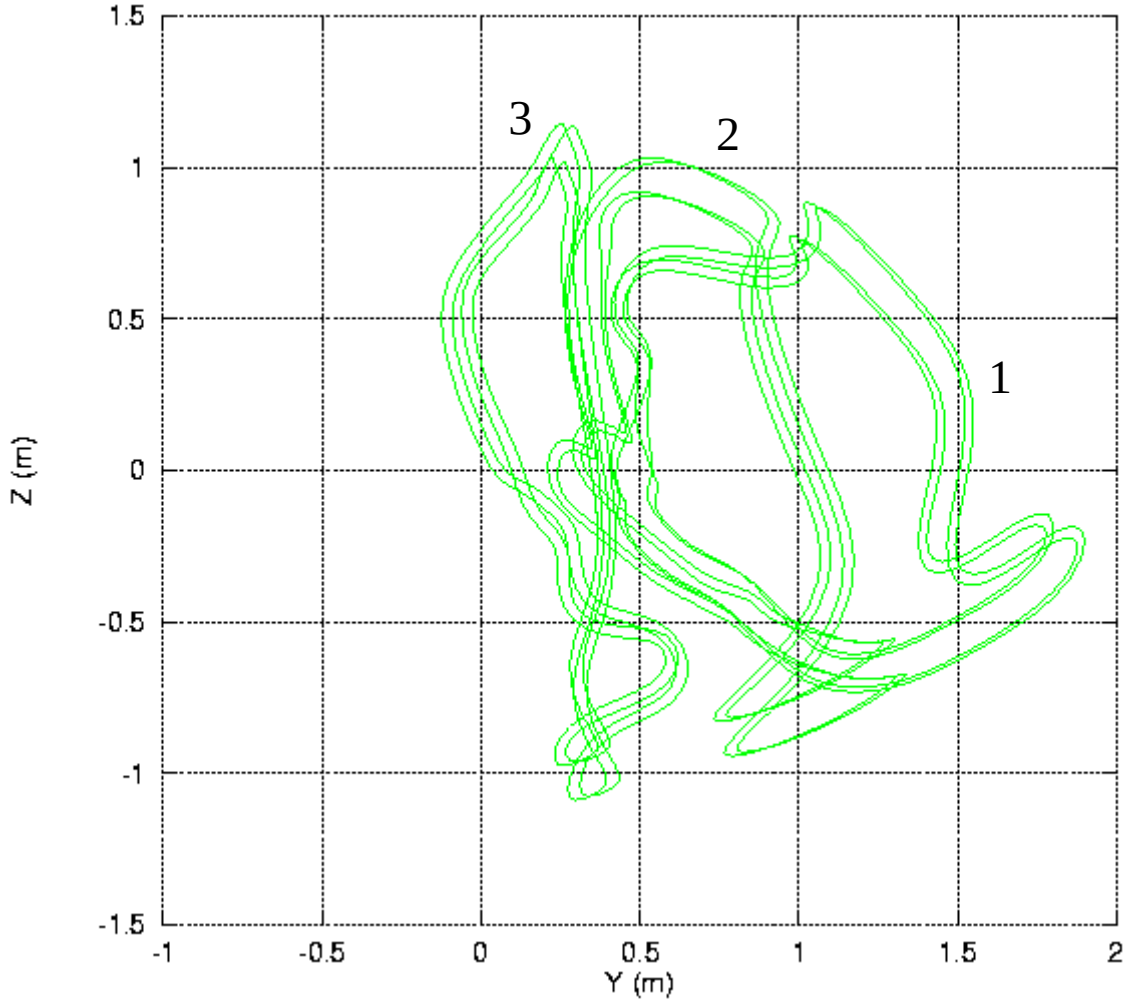
h = ± 6 cm

Four filament model – top view



h = ± 6 cm
w = ± 2 cm

Four filament model – side view



h = ± 6 cm
w = ± 2 cm

Status of multifilament coil model

- Implemented for new coil representation
- Tested for 3 and 4 filament modular coils
- Coil separation, radius of curvature constraints are based on central filament
- No optimization on ‘twist’ of coils

Status of Stellopt/Coilopt merger

- Coilopt modifications
  - Runs in ‘coil-geometry’ mode when called from Stellopt (no evaluation of field error)
  - Compiler directives to bypass MPI, LM (maintain single source)
  - Evaluates coil targets and writes coil filament file
- Stellopt modifications
  - Make system call to run xcoilgeom (coil engineering targets)
  - Make system call to run xgrid (generate mgrid file for vmec)
  - Parse output files to obtain engineering targets and coil currents

Coilopt tasks and plans

- Engineering constraints
  - Tangential access penalty function for nbi, diagnostics (in progress)
  - Penalty function for distance between coils and PFC/VV surface
- VF coils
  - VF coil position optimization
  - Include VF coils in calculation of coil separation penalties
- Multifilament optimization
  - Optimize on ‘twist’ of coils
  - Model variable web thickness
- Stellopt/Coilopt merger
  - Generalize subroutine to write coils for xgrid calculation
  - Merge recent Coilopt changes with latest Stellopt version (complete)