

CI-Beam-105

Lattice Design and Computational Dynamics Tutorial II

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Reminder

- ❖ Introduction
- ❖ Design and compute a regular lattice
- ❖ **Adjust global machine parameters**
- ❖ Induce machine imperfections and perform corrections
- ❖ Introduce straight sections
- ❖ Design injection and extraction sections
- ❖ Design a dispersion suppressing lattice

Tune Matching

- ▶ Start with your lattice in Exercise 1 and “match” the horizontal and vertical tunes to $Q_1 = 6.70$ and $Q_2=6.65$, respectively.
- ▶ For tune matching vary the strengths of the quadrupole magnets.

Tune Matching

```

use, sequence= ci_cell1;

match, sequence= ci_cell1;
  vary,name=kqf, step=0.00001;
  vary,name=kqd, step=0.00001;
  global,sequence= ci_cell1,Q1=6.700;
  global,sequence= ci_cell1,Q2=6.650;
  Lmdif, calls=10, tolerance=1.0e-21;
endmatch;

```

ex2.madx

20.11 WEIGHT, GWEIGHT
20.12 Matching Methods
20.12.1 LMDIF: Fast Gradient Minimisation
20.12.2 MIGRAD: Gradient Minimisation . .
20.12.3 SIMPLEX: Simplex Minimisation . .
20.12.4 JACOBIAN: Newton Minimisation . .
20.13 USE MACRO

ex2.seq

```

// Define the quadrupoles as multipoles.
!qf: multipole,knl={0,9.8e-3*lq};
!qd: multipole,knl={0,-9.8e-3*lq};
kqf = 9.8e-3;
kqd = -9.8e-3;
qf: multipole, knl:={0,lq*kqf};
qd: multipole, knl:={0,lq*kqd};

```

Exercise 2

MATCH SUMMARY

Node_Name	Constraint	Type	Target Value	Final Value	Penalty
Global constraint:	q1	4	6.70000000E+00	6.70957016E+00	9.15879885E-03
Global constraint:	q2	4	6.65000000E+00	6.65876138E+00	7.67617337E-03

Final Penalty Function = 1.68349722e-02

Variable	Final Value	Initial Value	Lower Limit	Upper Limit
kqf	2.31764e-02	9.80000e-03	-1.00000e+20	1.00000e+20
kqd	-2.30846e-02	-9.80000e-03	-1.00000e+20	1.00000e+20

END MATCH SUMMARY

++++++ table: summ

length	orbit5	alfa	gammatr
1000	-0	0.0289164183	5.880682749
q1	dq1	betxmax	dxmax
6.709570161	-11.18701482	108.5692794	7.452809984
dxrms	xcomax	xcorms	q2
5.08796947	0	0	6.658761377
dq2	betymax	dymax	dyrms
-11.03245881	107.7592831	0	0
ycomax	ycorms	deltap	synch_1
0	0	0	0
synch_2	synch_3	synch_4	synch_5
0	0	0	0

Chromaticity Matching

- ▶ “Match” the horizontal and vertical chromaticity to $dQ1 = 0.0$ and $dQ2=0.0$, respectively.
- ▶ For chromaticity matching add sextupoles to your sequence and vary their strengths.

Chromaticity Matching

ex2c.madx

```

match, sequence=ci_cell1;
  vary,name=ksf, step=0.00001;
  vary,name=ksd, step=0.00001;
  global,sequence=ci_cell1,DQ1=0.0;
  global,sequence=ci_cell1,DQ2=0.0;
  Lmdif, calls=10, tolerance=1.0e-21;
endmatch;

```

ex2c.seq

```

// Define the sextupoles as multipoles
ksf = +0.017041/20.0;
ksd = -0.024714/20.0;

// Attention: = is not equal to := for matching!
msf: multipole, knl:={0,0,ksf*lsex};
msd: multipole, knl:={0,0,ksd*lsex};

// Define the sequence.
ci_cell1: sequence, refer=centre, l=circum;
start_machine: marker, at = 0;
!
  n = 1;
  while (n < ncell+1) {
  qf: qf, at=(n-1)*lcell;
  msf: msf, at=(n-1)*lcell + lsex/2.0;
  mb: mb, at=(n-1)*lcell+0.15*lcell;
  mb: mb, at=(n-1)*lcell+0.35*lcell;
  qd: qd, at=(n-1)*lcell+0.50*lcell;
  msd: msd, at=(n-1)*lcell+0.50*lcell + lsex/2.0;
  mb: mb, at=(n-1)*lcell+0.65*lcell;
  mb: mb, at=(n-1)*lcell+0.85*lcell;
  !
  n = n + 1;
  }
end_machine: marker at=circum;
endsequence;

```

Exercise 2

MATCH SUMMARY

Node_Name	Constraint	Type	Target Value	Final Value	Penalty
Global constraint:	dq1	4	0.00000000E+00	1.15933414E-14	1.34405565E-28
Global constraint:	dq2	4	0.00000000E+00	-6.39504772E-14	4.08966353E-27

Final Penalty Function = 4.22406909e-27

Variable	Final Value	Initial Value	Lower Limit	Upper Limit
ksf	9.31788e+02	8.52050e-04	-1.00000e+20	1.00000e+20
ksd	-2.34982e+03	-1.23570e-03	-1.00000e+20	1.00000e+20

++++++ table: summ

length	orbit5	alfa	gammatr
1000	-0	0.02897270629	5.874967495
q1	dq1	betxmax	dxmax
6.7	1.159334141e-14	108.3355089	7.463774993
dxrms	xcomax	xcorms	q2
5.245457666	0	0	6.65
dq2	betymax	dymax	dyrms
-6.395047716e-14	107.5469959	0	0
ycomax	ycorms	deltap	synch_1
0	0	0	0
synch_2	synch_3	synch_4	synch_5
0	0	0	0

Exercise 2

