

Contents

1	Introduction	1
2	Fundamentals	3
2.1	Physics	3
2.1.1	Electric charge and current	3
2.1.2	Coulomb's law	5
2.1.3	Magnetism in vacuum	9
2.1.4	Magnetic moment and magnetization	11
2.1.5	Magnetic fields in matter	12
2.1.6	Electromagnetic induction and Faraday's law	16
2.2	Magnetic particle imaging	17
2.2.1	The particle model	17
2.2.2	Signal generation	18
2.2.3	Spatial encoding	19
2.2.4	Reconstruction in MPI	21
2.2.5	Raw data	22
2.2.6	Reconstruction step	23
2.3	Electric Networks	24
2.3.1	Fundamental dipoles	24
2.3.2	Kirchhoff's laws	26
2.3.3	Interaction of network components	27
2.3.4	Hardware filtering	29
2.4	Shielding	31

2.4.1	Skin effect	32
3	Materials and Methods	35
3.1	Coil and magnet assembly	35
3.1.1	Generation of a rotatable field free line	35
3.1.2	Translation of the FFL and signal generation	37
3.1.3	Installation and receiving coils	39
3.2	Overview of the signal chain	39
3.3	Transmission chain	41
3.3.1	Impedance matching	43
3.4	Receiving chain	46
3.5	Selection field signal	47
3.6	Practical realization	48
3.6.1	Shielding	48
4	Results	51
4.1	Transmission filter	51
4.2	Receiving filter	54
4.3	Power filter	57
5	Discussion	59
6	Conclusion	63
7	Bibliography	65