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Texture features for registration

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Feature selection for image registration

- Features
  - Intensity
  - Geometrical
  - Texture
- Feature correspondence is measured by similarity measure (SM)
- Optimization of transformation parameters until SM is maximized
- Motivation: how to select the features for correct registration

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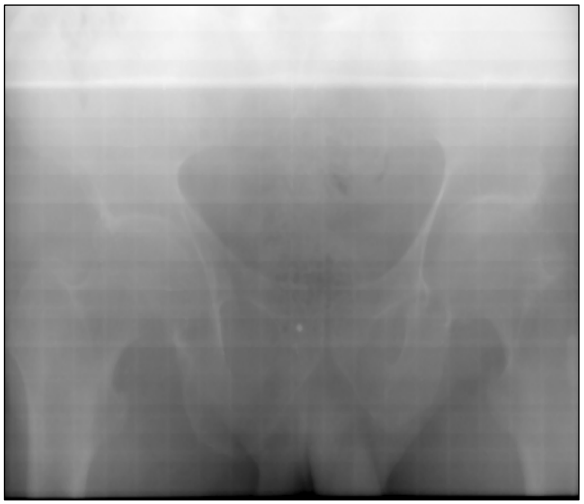
Experiment design

- Image modalities: DRR (Digital reconstructed radiograph) and EPI (Electron portal images)

DRR image (490 x 375 pxl)



EPI image (490 x 375 pxl)

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Experiment design

- Image modalities: DRR (Digital reconstructed radiograph) and EPI (Electron portal images)
- Extraction of texture features
- What we obtain after filtering: texture energy images (t.e.i.)
- For each corresponding pair of t.e.i. we estimate MI (Mutual Information) for horizontal translation from -40:+40 pxls (-20:+20 mm)
- Two interpolation methods have been used in order to estimate int. artefacts : linear and partial volume interpolation

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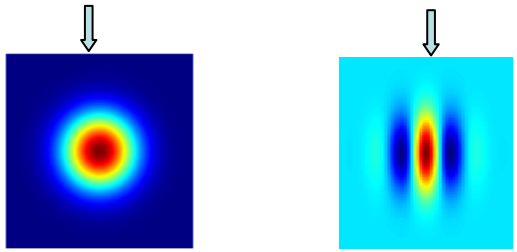
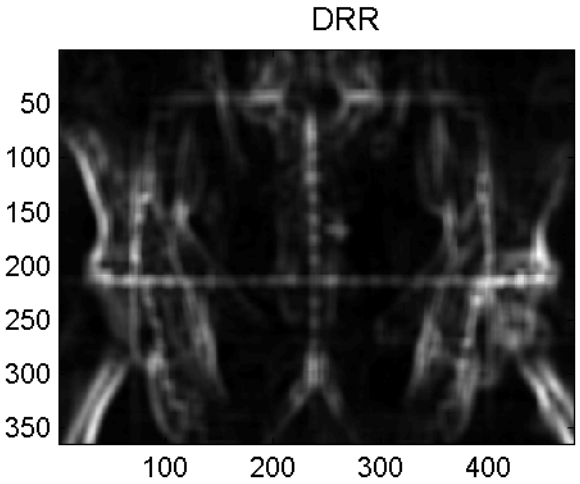
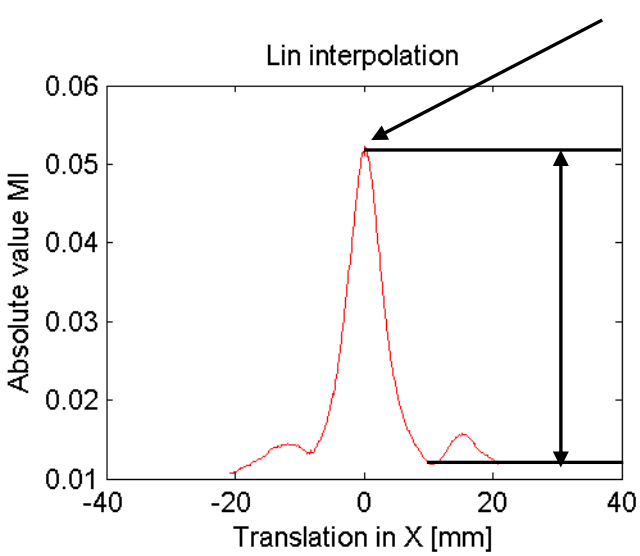
Methods

- Comparison:
  - Laws texture coefficient
  - Gabor texture features
  - Intensity features
- Laws:
  - 3 texture features: E5L5-L5E5, S5L5-L5S5 and E5S5-S5E5
  - 5 different window sizes (F0=3,5,9,17,33)=>15 texture energy images)
- Gabor filters:
  - 5 frequencies (F0=2,4,8,16,32)
  - 6 orientations (θ=0,30,60,90,120,150°)=> 30 texture energy images)=> absolute and real component



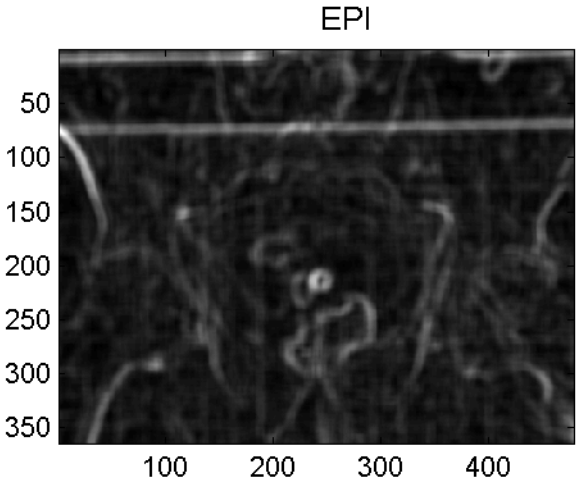
Results-Laws t.f. E5L5_L5E5, F0=9

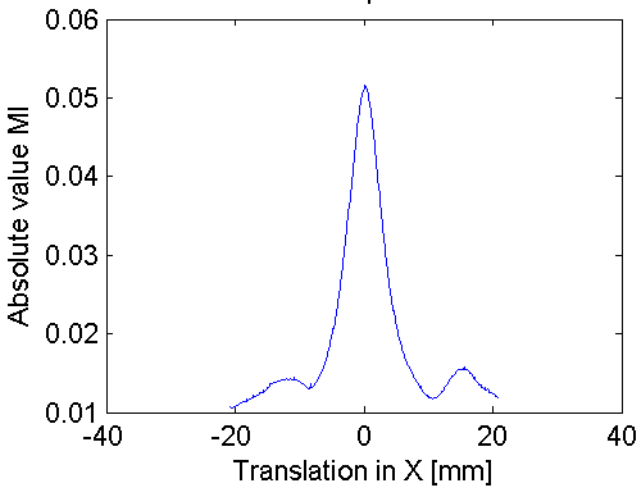




Accuracy

Distinctiveness of the global extreme





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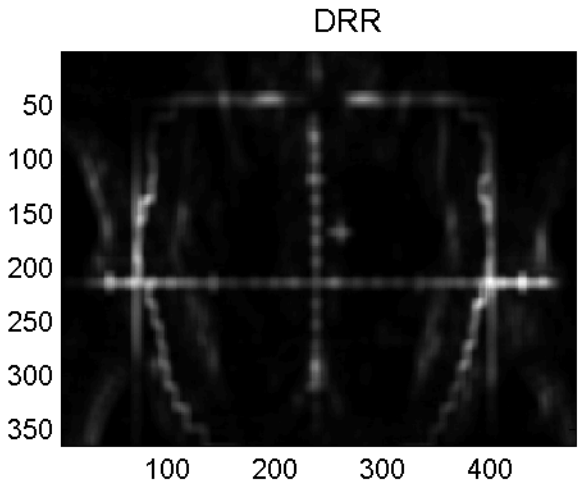
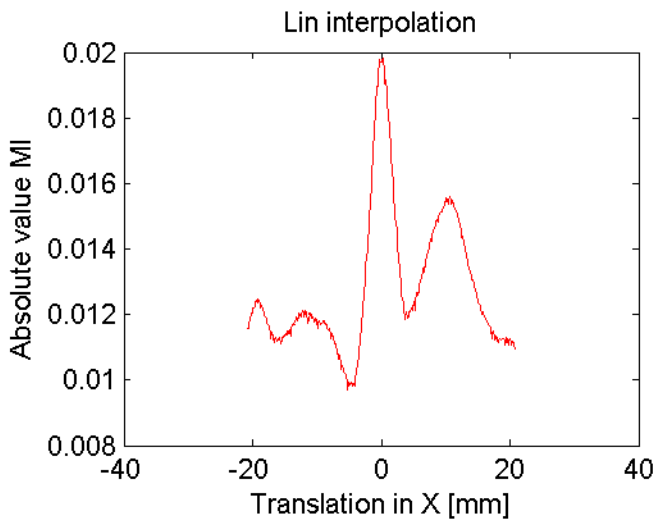
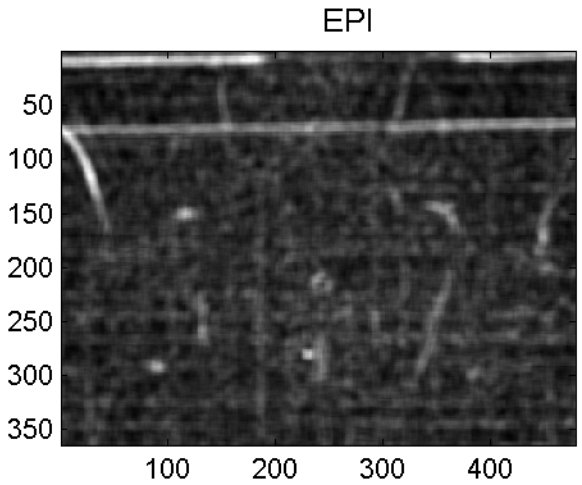
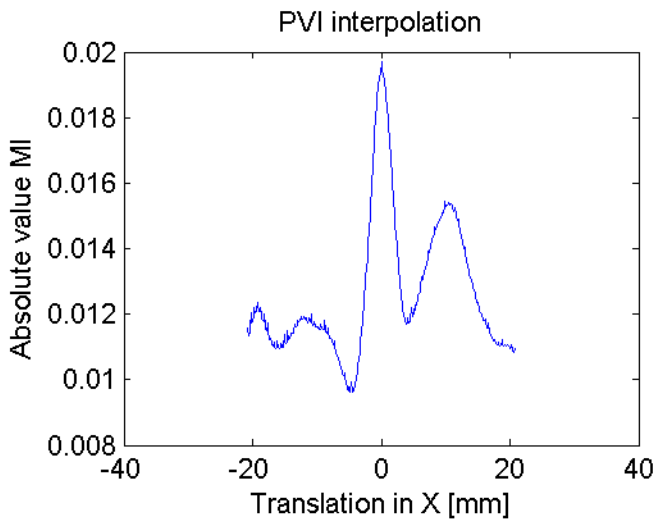
Results-Laws t.f. S5L5_L5S5, F0=9









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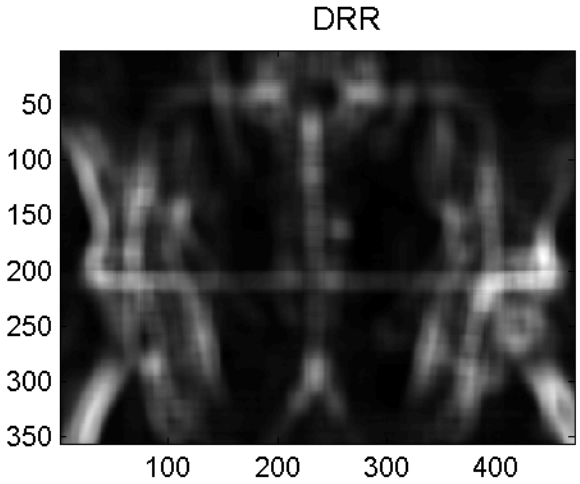
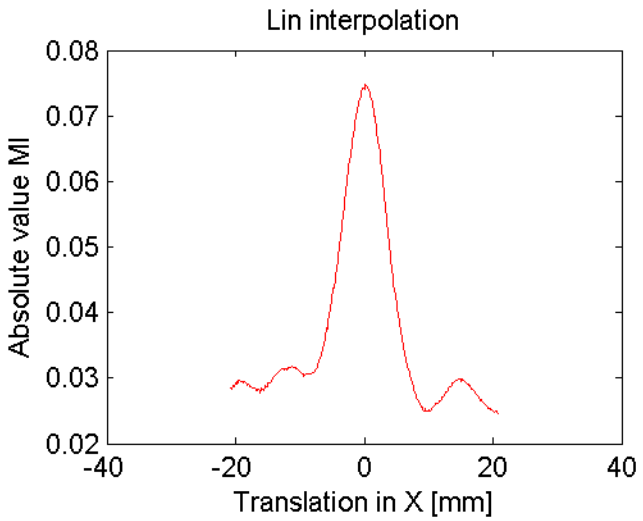
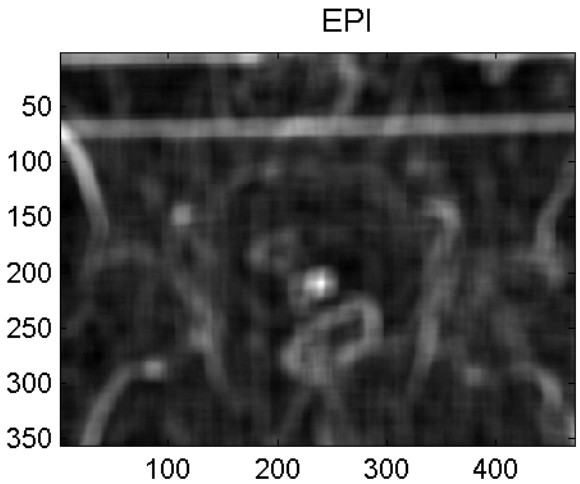
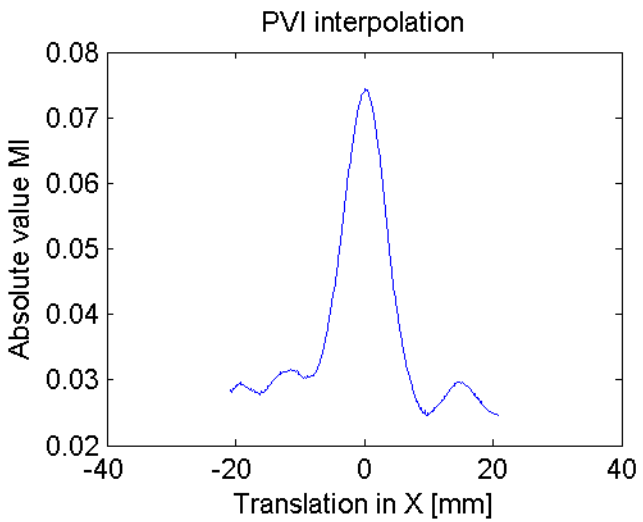
Results-Laws t.f. E5L5_L5E5, F0=17









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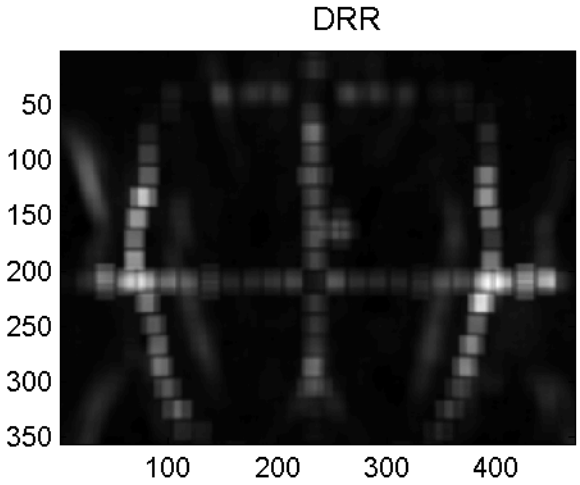
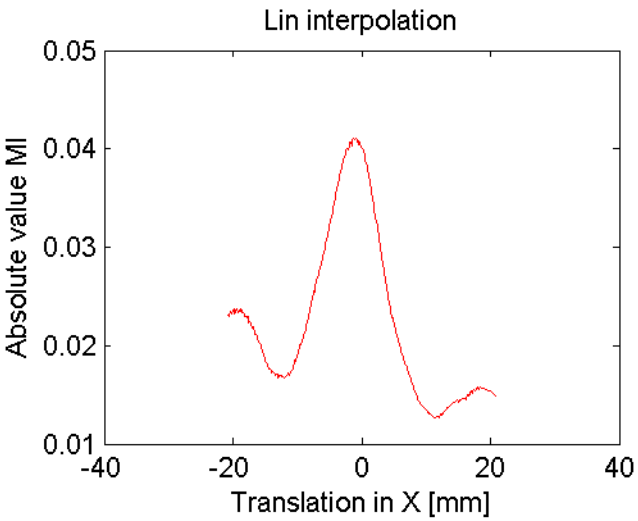
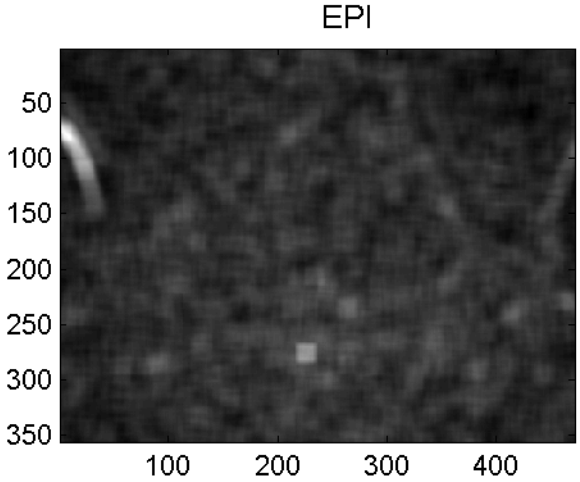
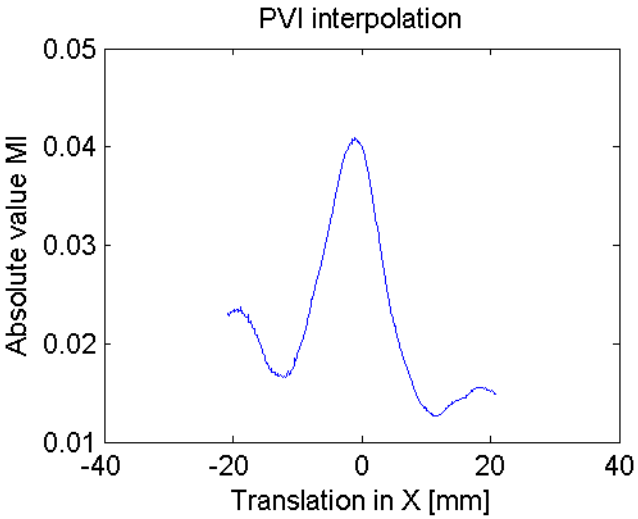
Results-Laws t.f. E5S5_S5E5, F0=17









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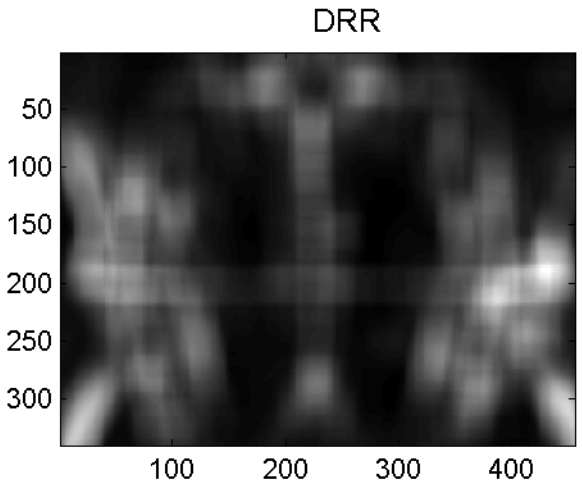
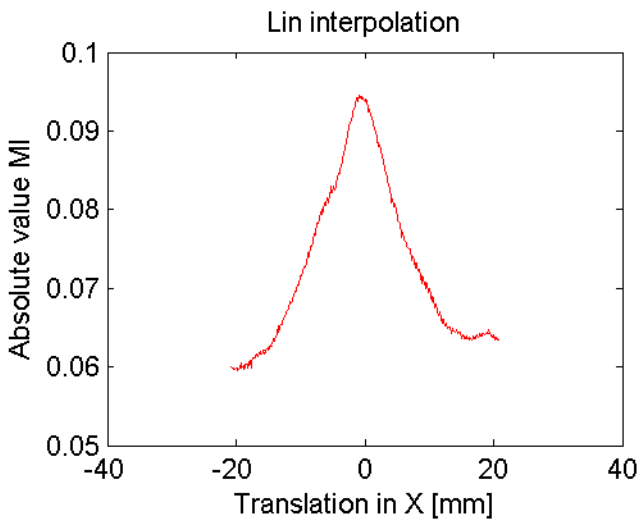
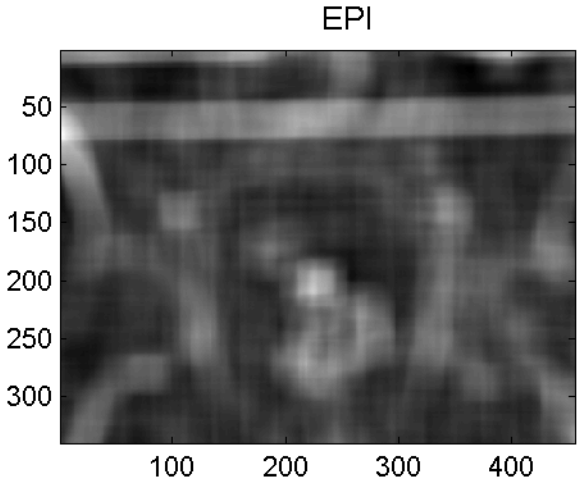
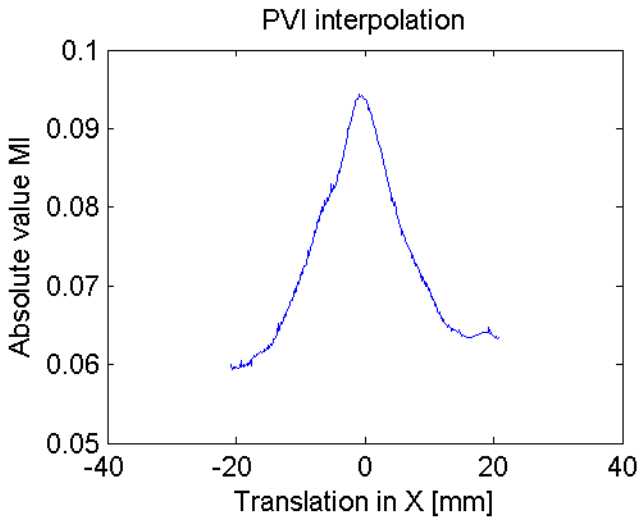
Results-Laws t.f. E5L5-L5E5, F0=33









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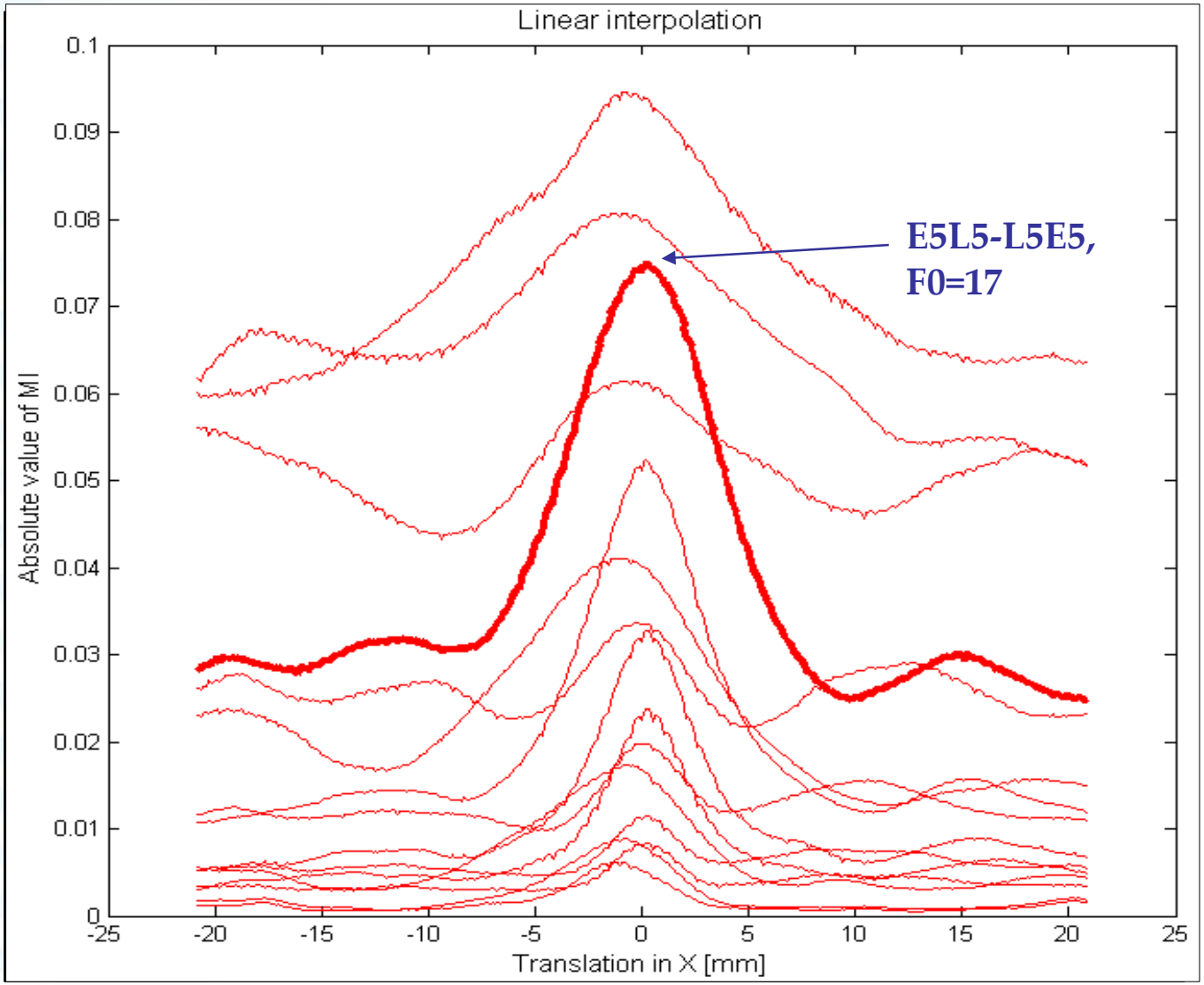
Results-Laws together



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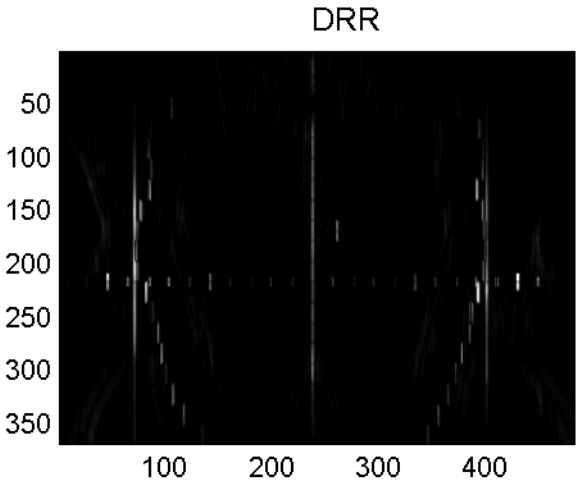
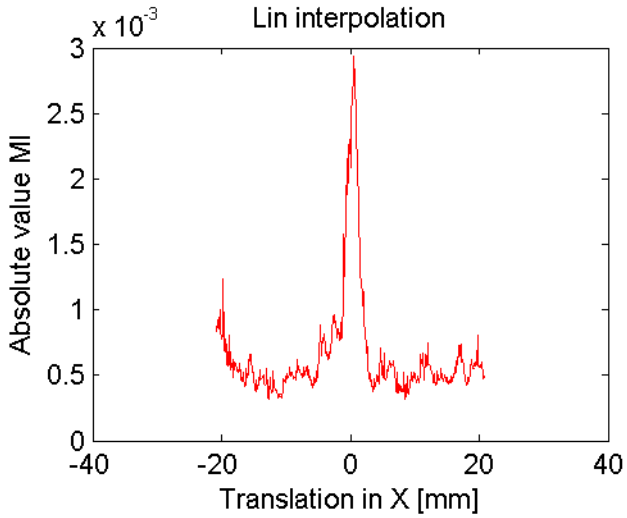
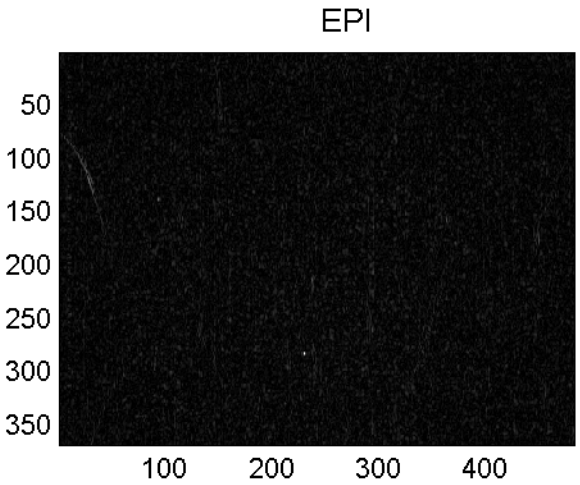
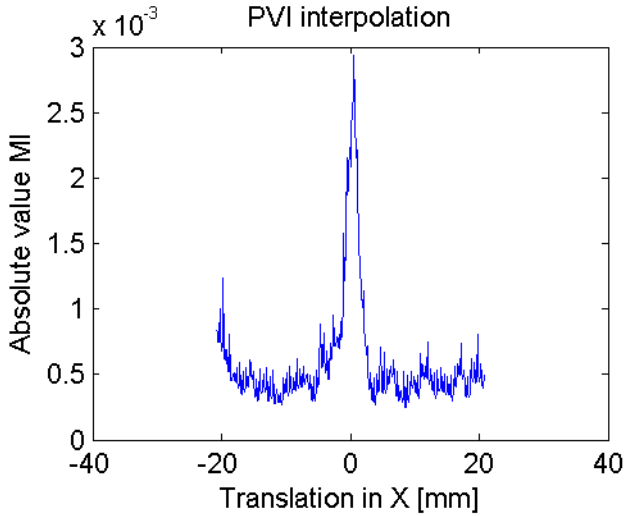
Results-Gabor t.f. Abs, F0=2,θ =0°









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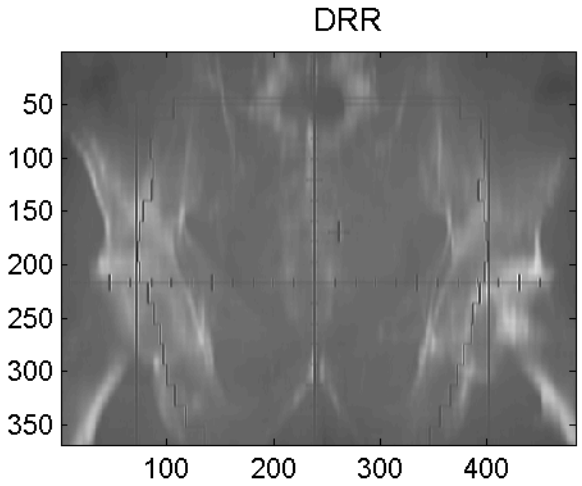
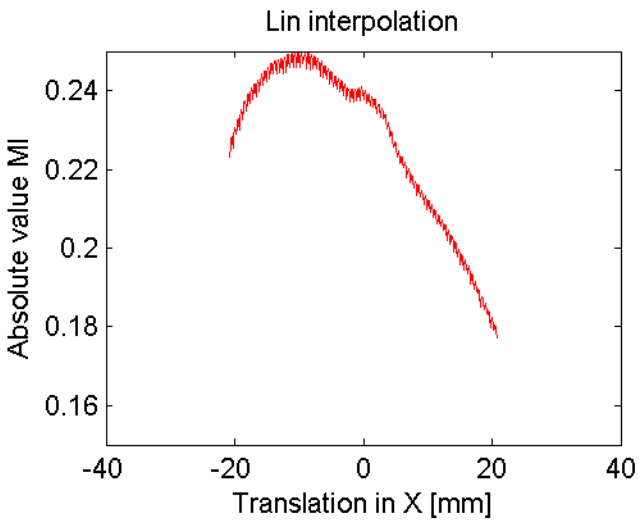
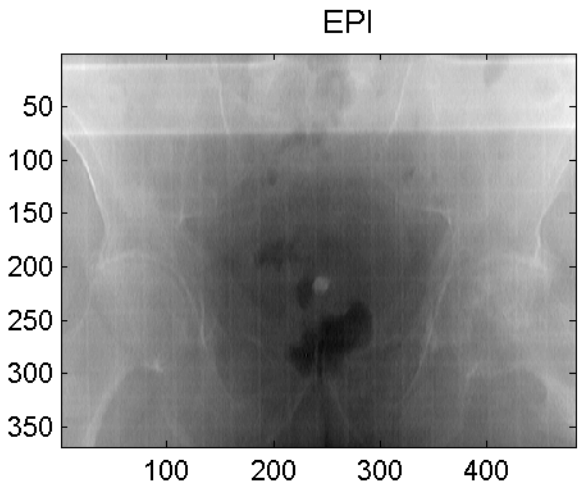
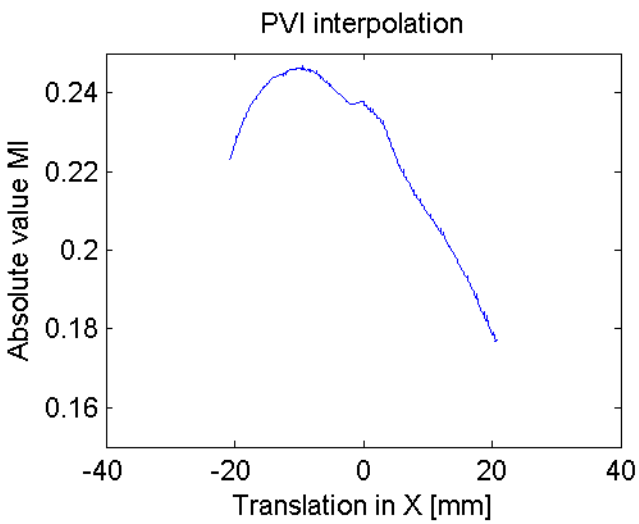
Results-Gabor t.f. Real, F0=2,θ =0°









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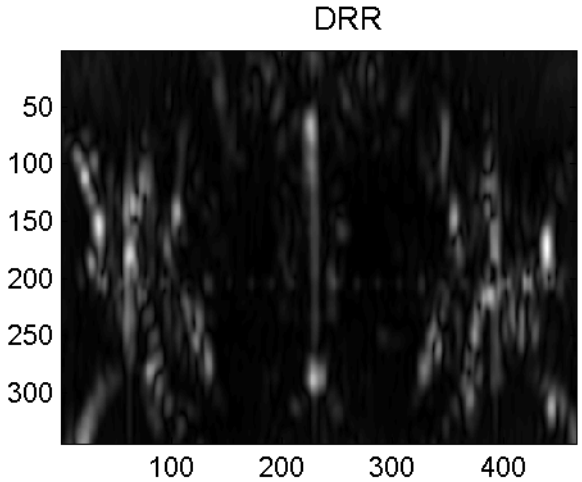
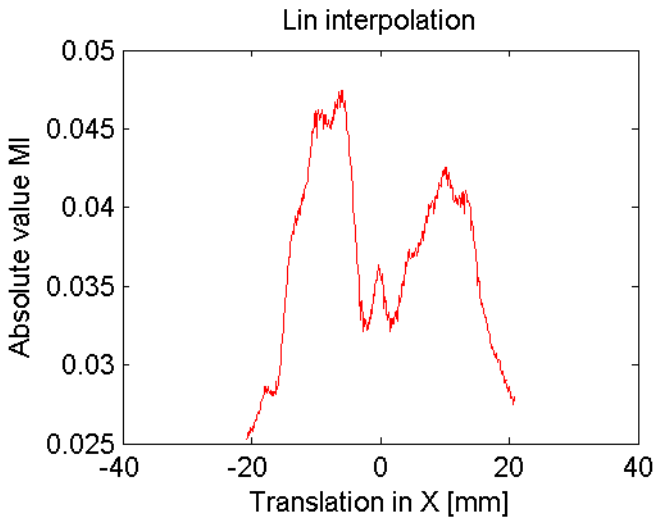
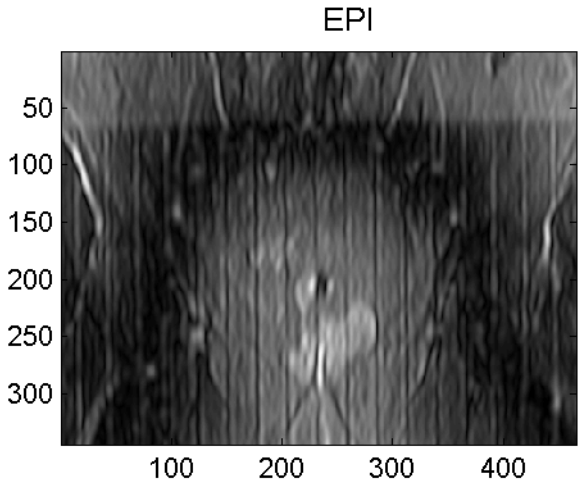
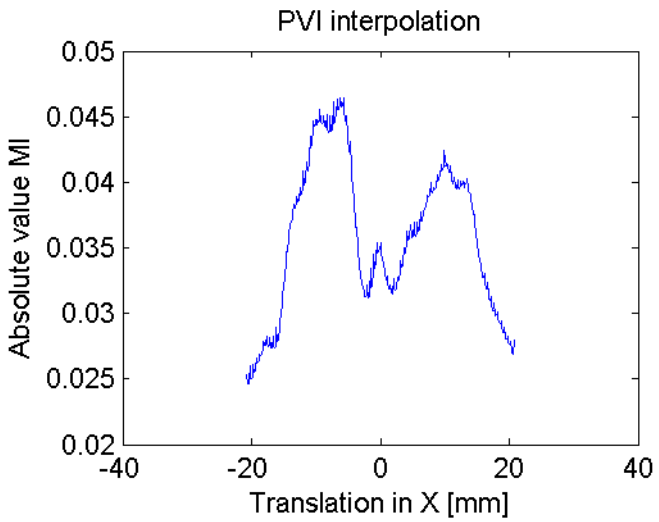
Results-Gabor t.f. Abs, F0=8,θ =0°









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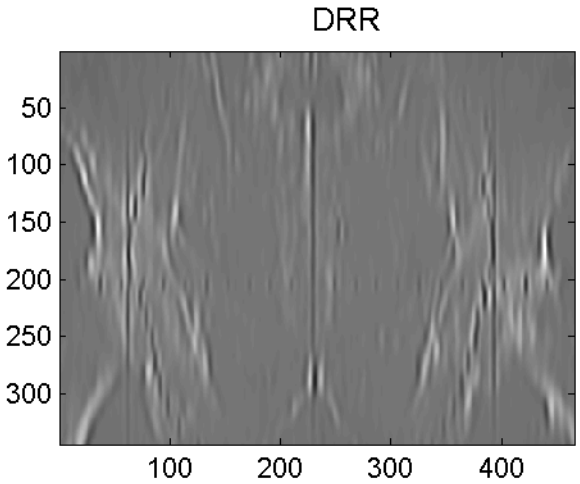
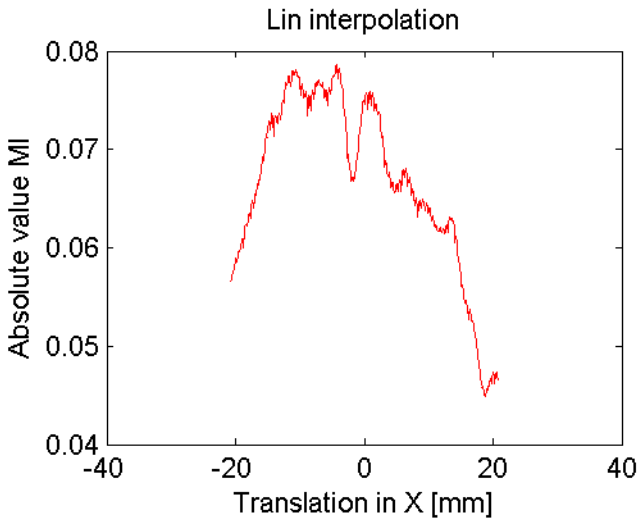
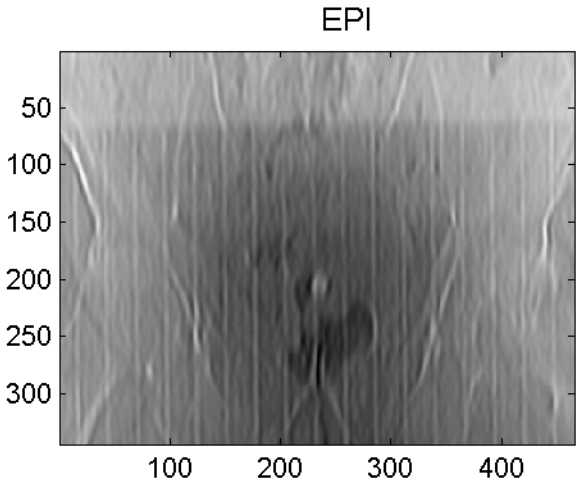
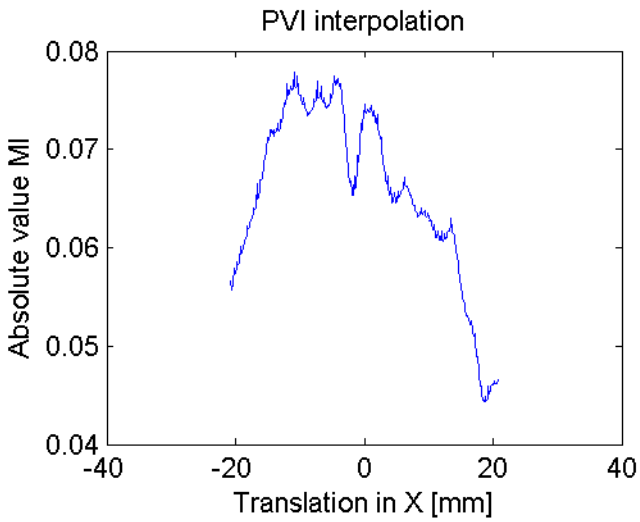
Results-Gabor t.f. Real, F0=8,θ =0°









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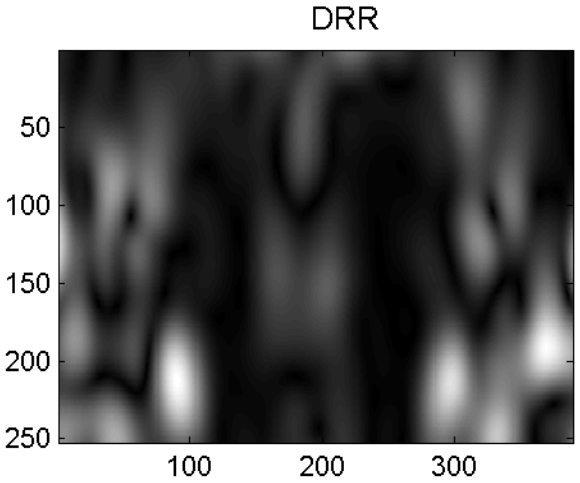
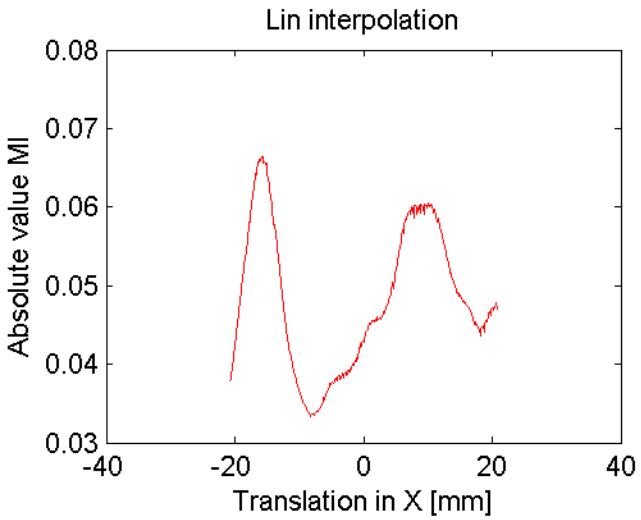
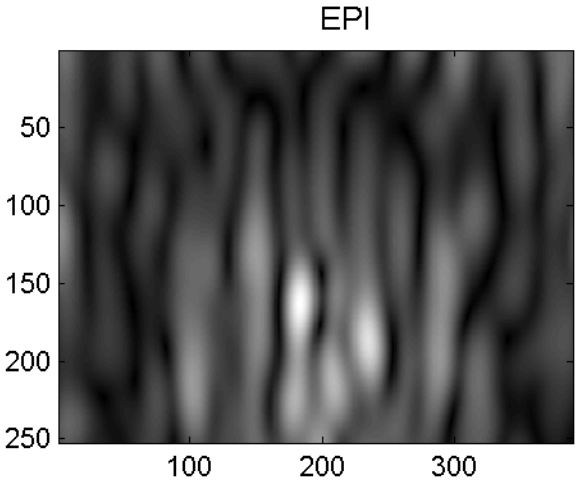
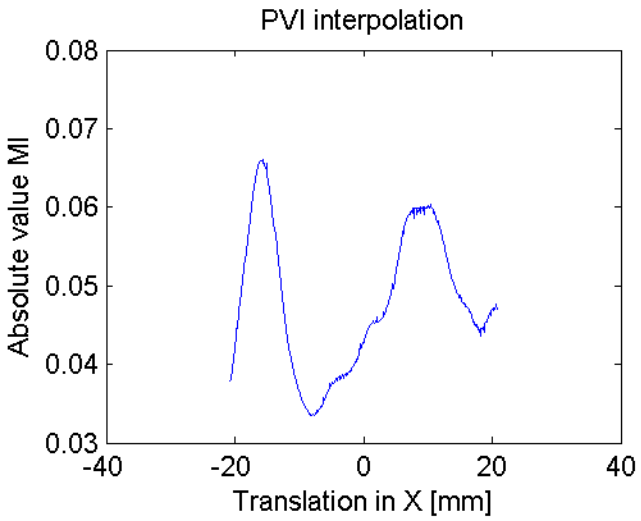
Results-Gabor t.f. Abs, F0=32,θ =0°









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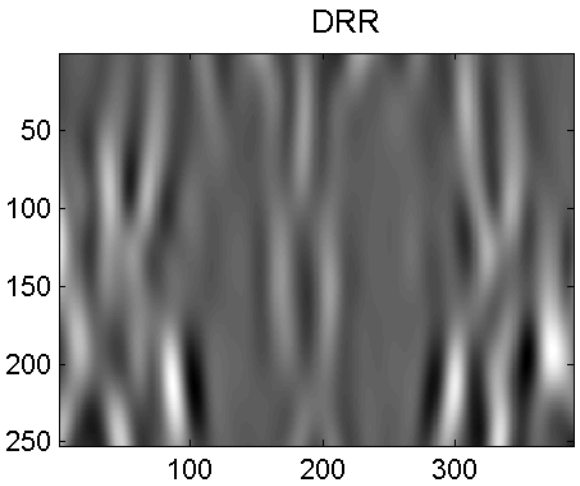
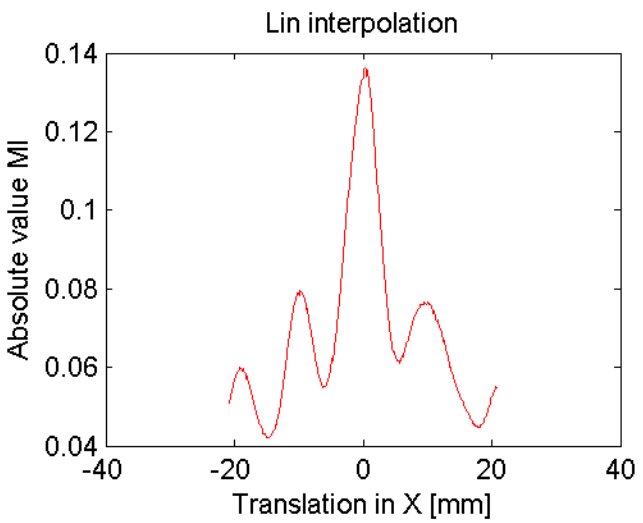
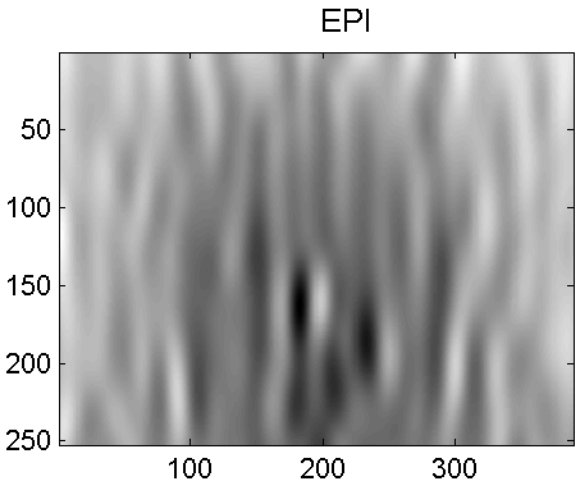
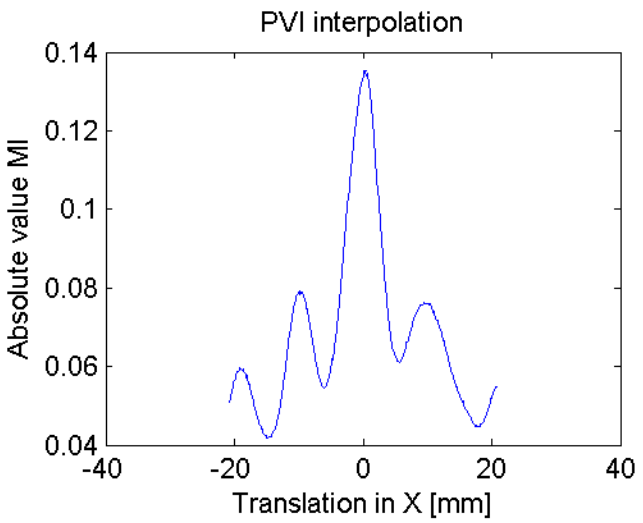
Results-Gabor t.f. Real, F0=32,θ =0°









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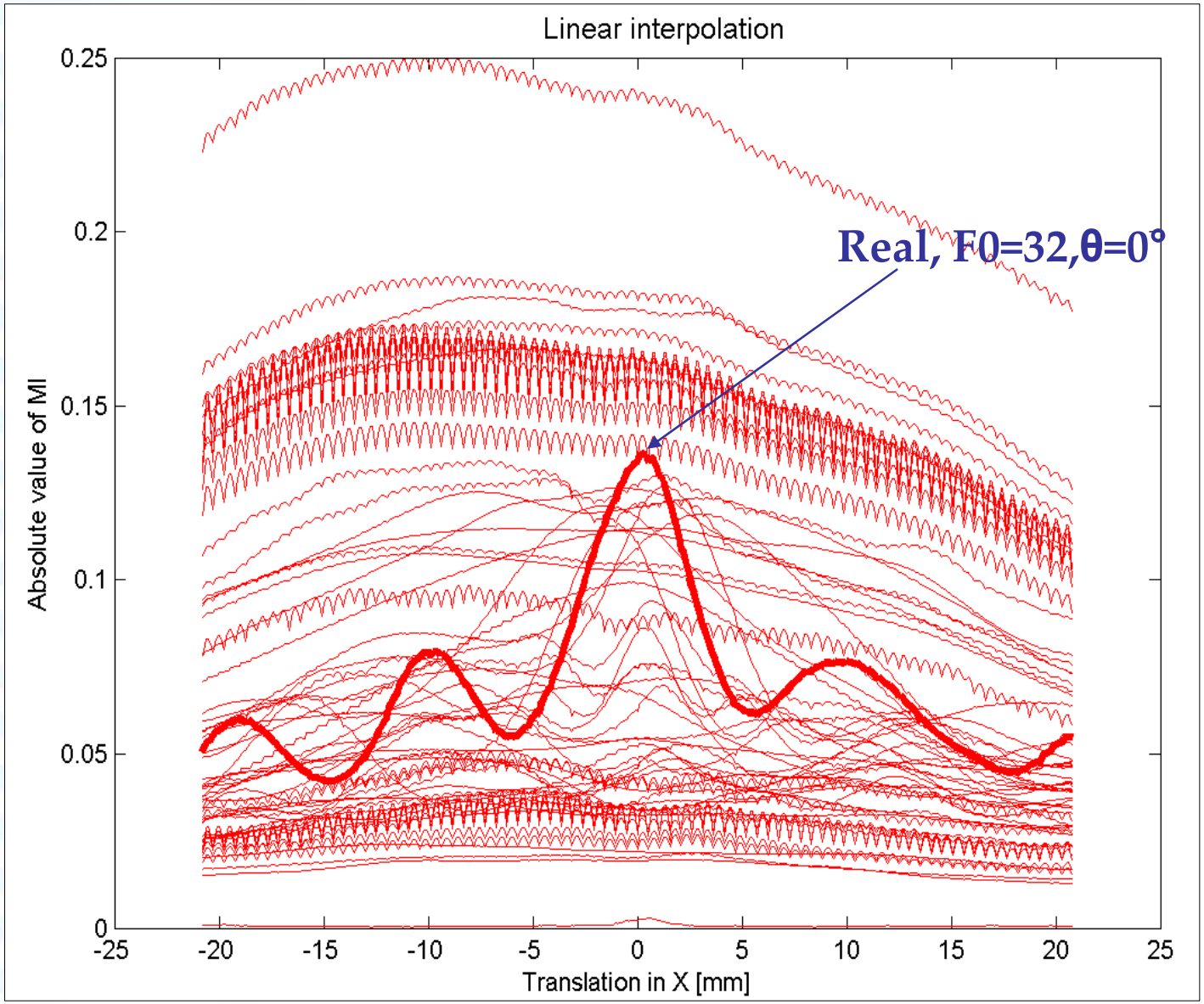
Results-Gabor together



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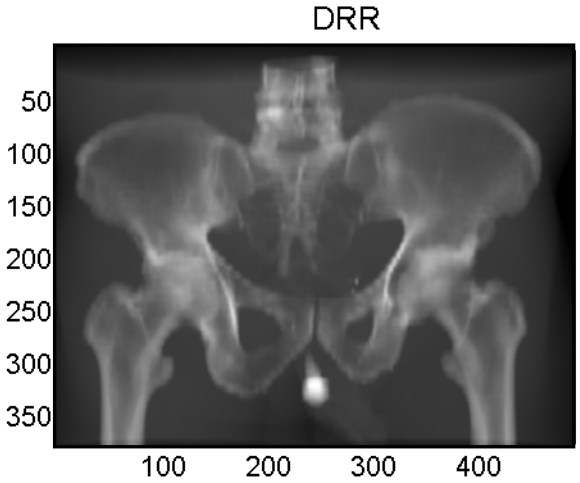
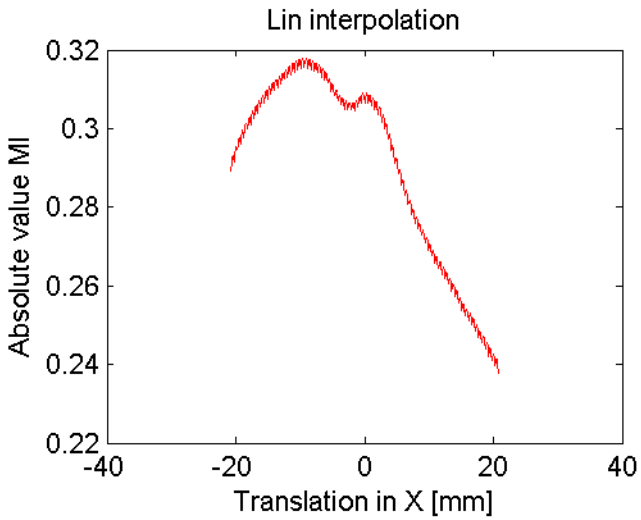
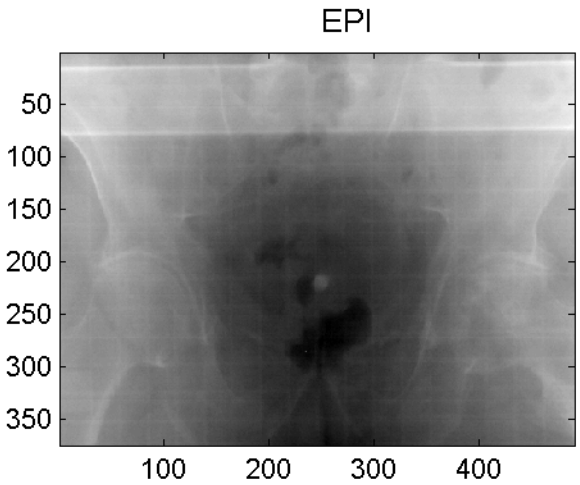
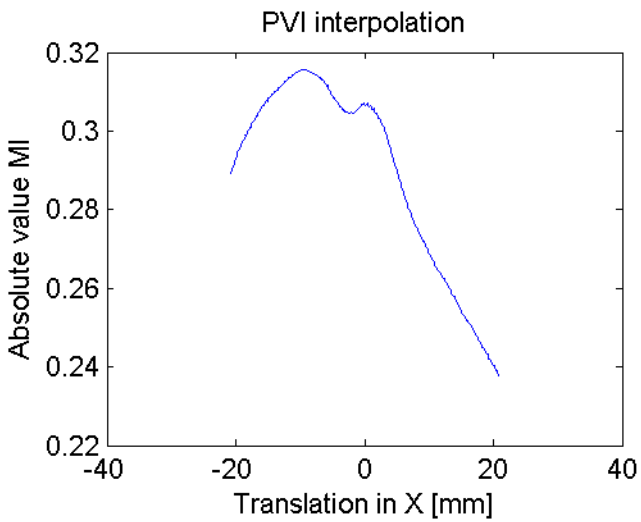
Results-Intensities









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Conclusions

- Laws t.f. would perform more correct registration than Gabor t.f. or intensity features
- MI based on Laws t.f. shows distinctive global extreme at the zero position
- Also some Gabor t.f. perform well
- Linear i. vs. Partial volume i.
- Outlook: automatic search for the features which would deliver optimal registration