Temporal effects in EIT image reconstructions

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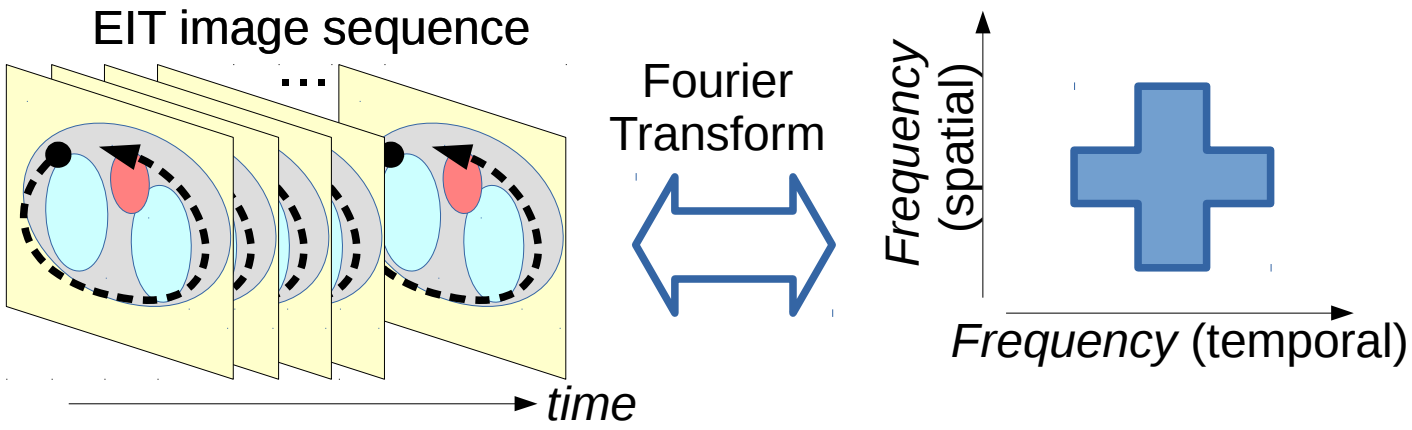
Introduction

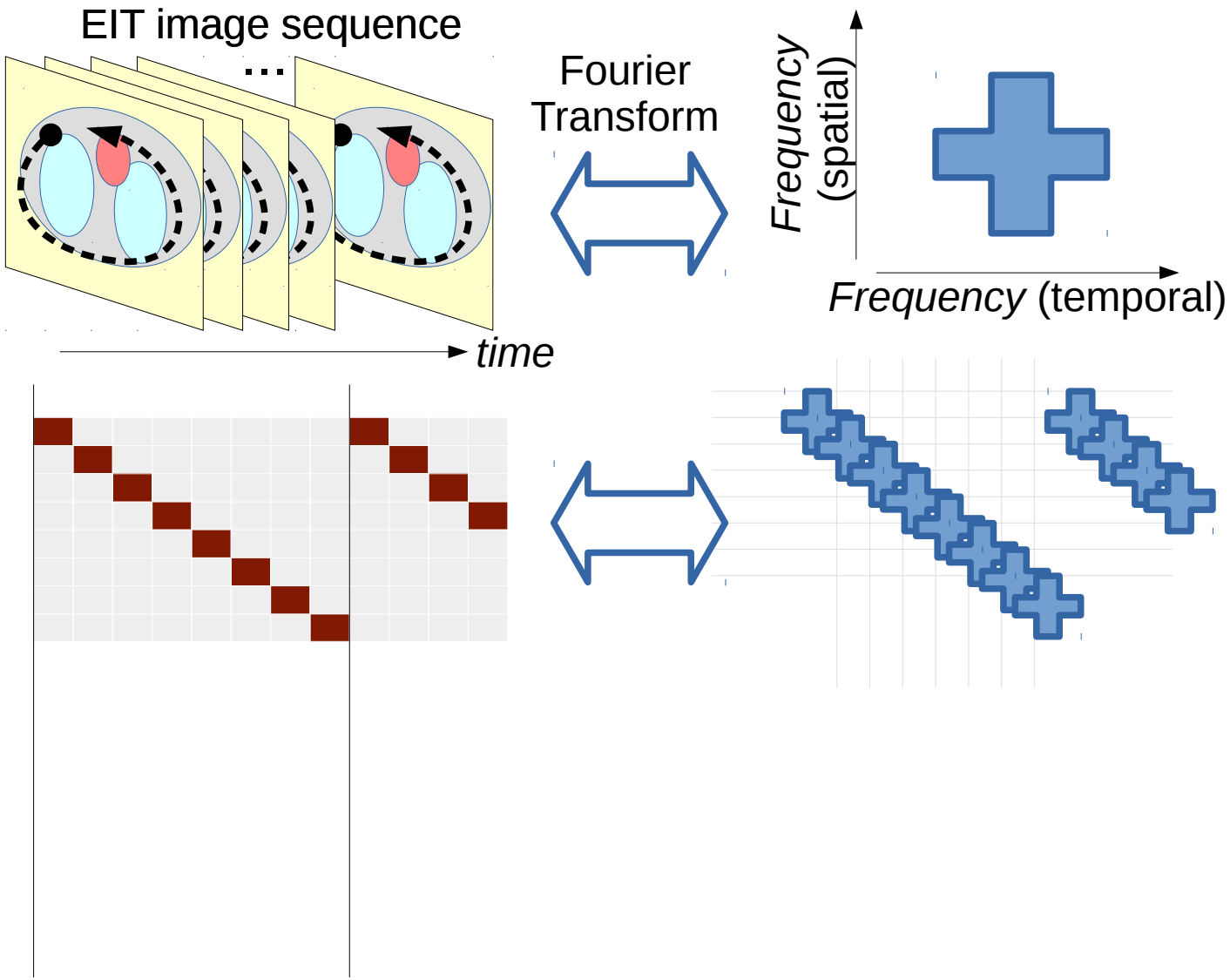
- Reconstruction Algs assume that:
  - Conductivity distribution does not change during acquisition of an EIT data frame;
  - Successive EIT frames are not correlated.
- However, in reality, frames are correlated
- Methods to account for temporal effects:
  - Kalman filter
  - Temporal EIT reconstruction
  - Interpolation of EIT measurements
- Our questions:
  - When do we need to worry about artefacts?
  - How much do algorithms help?

Frequency domain representation



Frequency domain representation

- **Introduction**
- Methods
- Results
- Discussion and Conclusion



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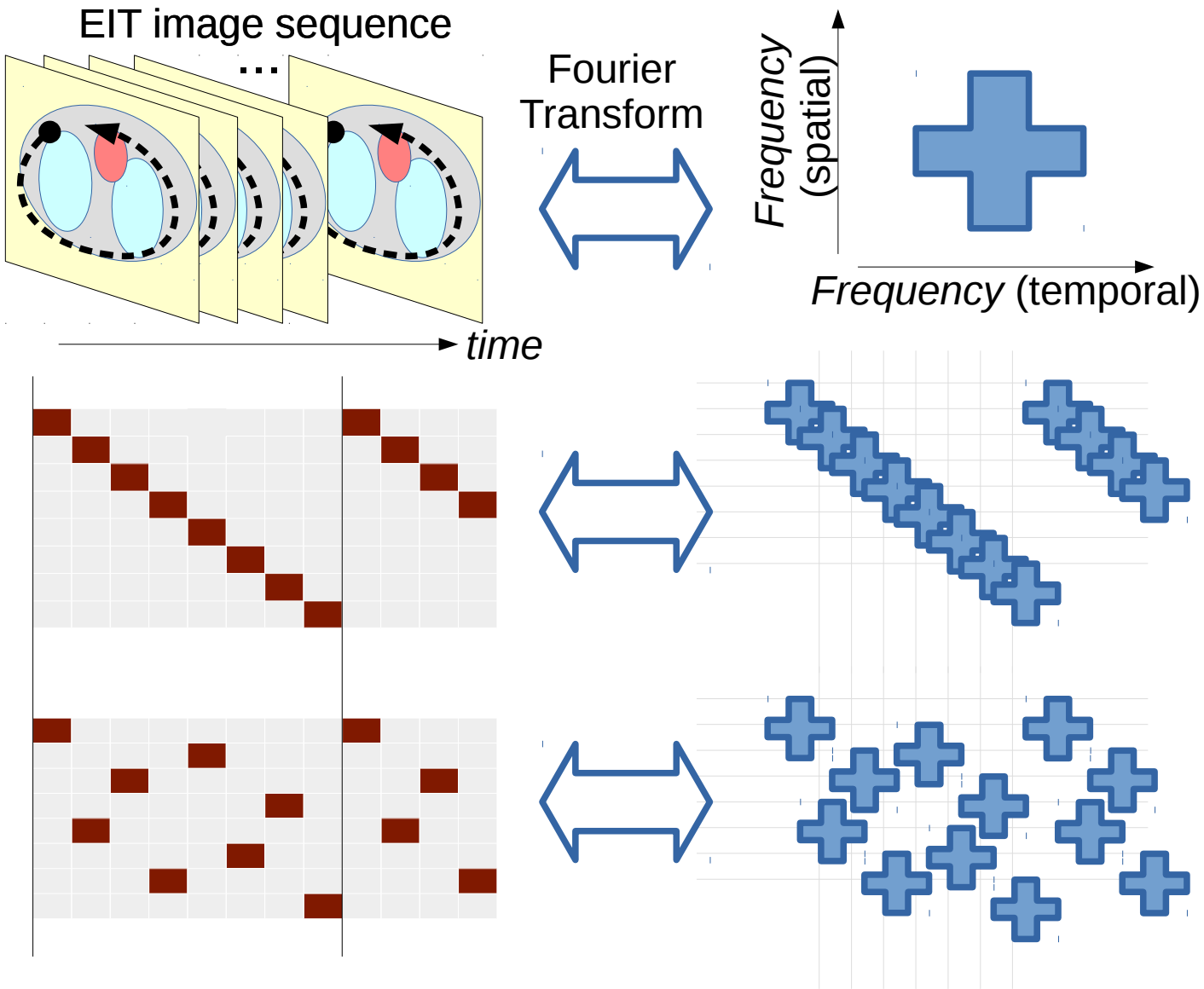
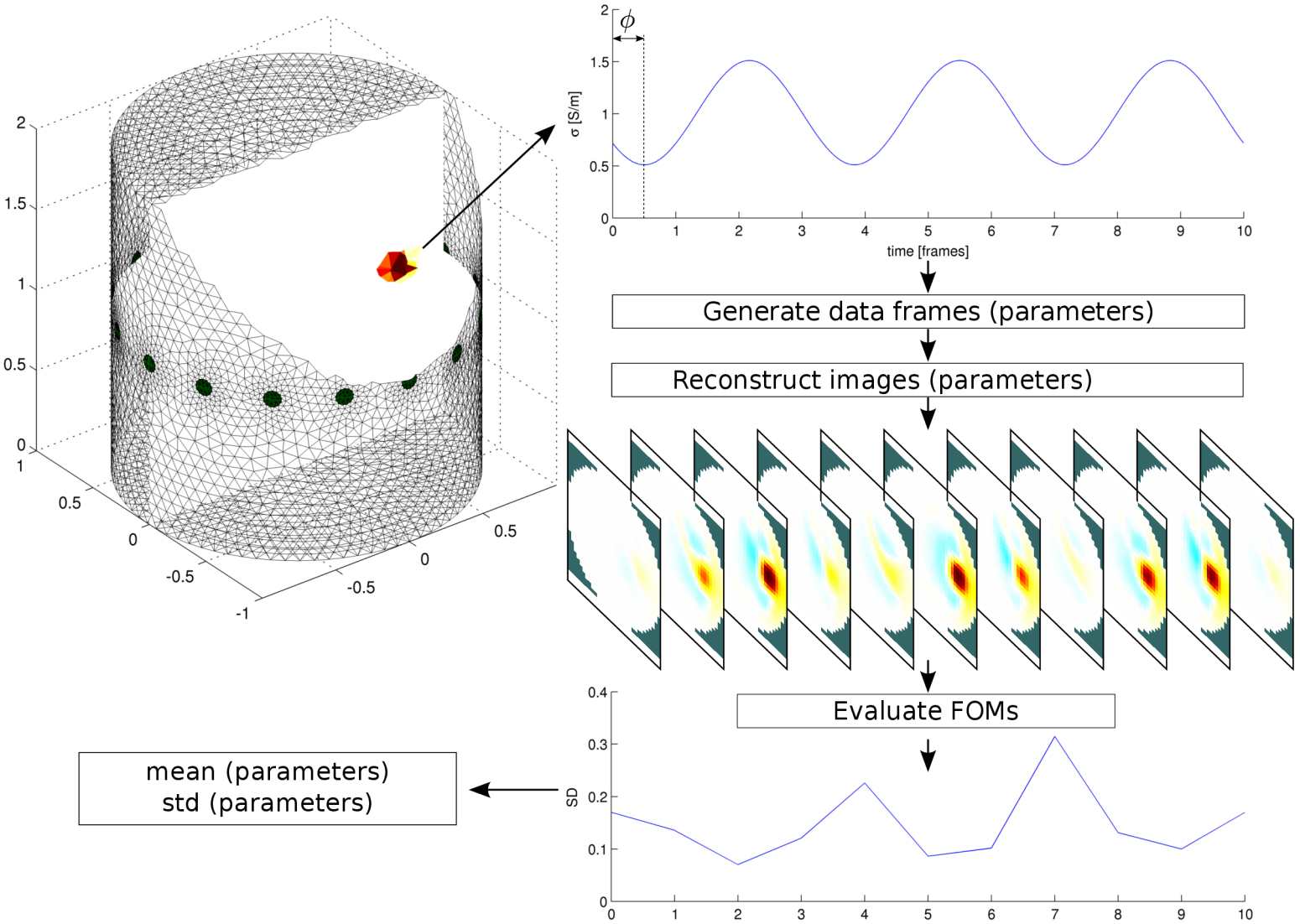


Overview of the method

- Introduction
- **Methods**
- Results
- Discussion and Conclusion



Types of EIT frames

- Perfect EIT frames:

$$v_{\mathrm{p}}(nT_{\mathrm{f}}) = \begin{bmatrix} f_1[\sigma(nT_{\mathrm{f}})] \\ \vdots \\ f_{n_{\mathrm{m}}}[\sigma(nT_{\mathrm{f}})] \end{bmatrix}$$

- Realistic EIT frames:

$$v_{\mathrm{r}}(nT_{\mathrm{f}}) = \begin{bmatrix} f_1[\sigma(nT_{\mathrm{f}})] \\ \vdots \\ f_{n_{\mathrm{m}}}[\sigma(nT_{\mathrm{f}} + (n_{\mathrm{m}} - 1)T_{\mathrm{m}})] \end{bmatrix}$$

- Interpolated EIT frames:

$$[v_{\mathrm{i}}(nT_{\mathrm{f}})]_i = \frac{(i-1)\left[v_{\mathrm{r}}\left((n-1)T_{\mathrm{f}}\right)\right]_i + (n_{\mathrm{m}} - i + 1)[v_{\mathrm{r}}(nT_{\mathrm{f}})]_i}{n_{\mathrm{m}}}$$

One cycle of conductivity variation

- Introduction
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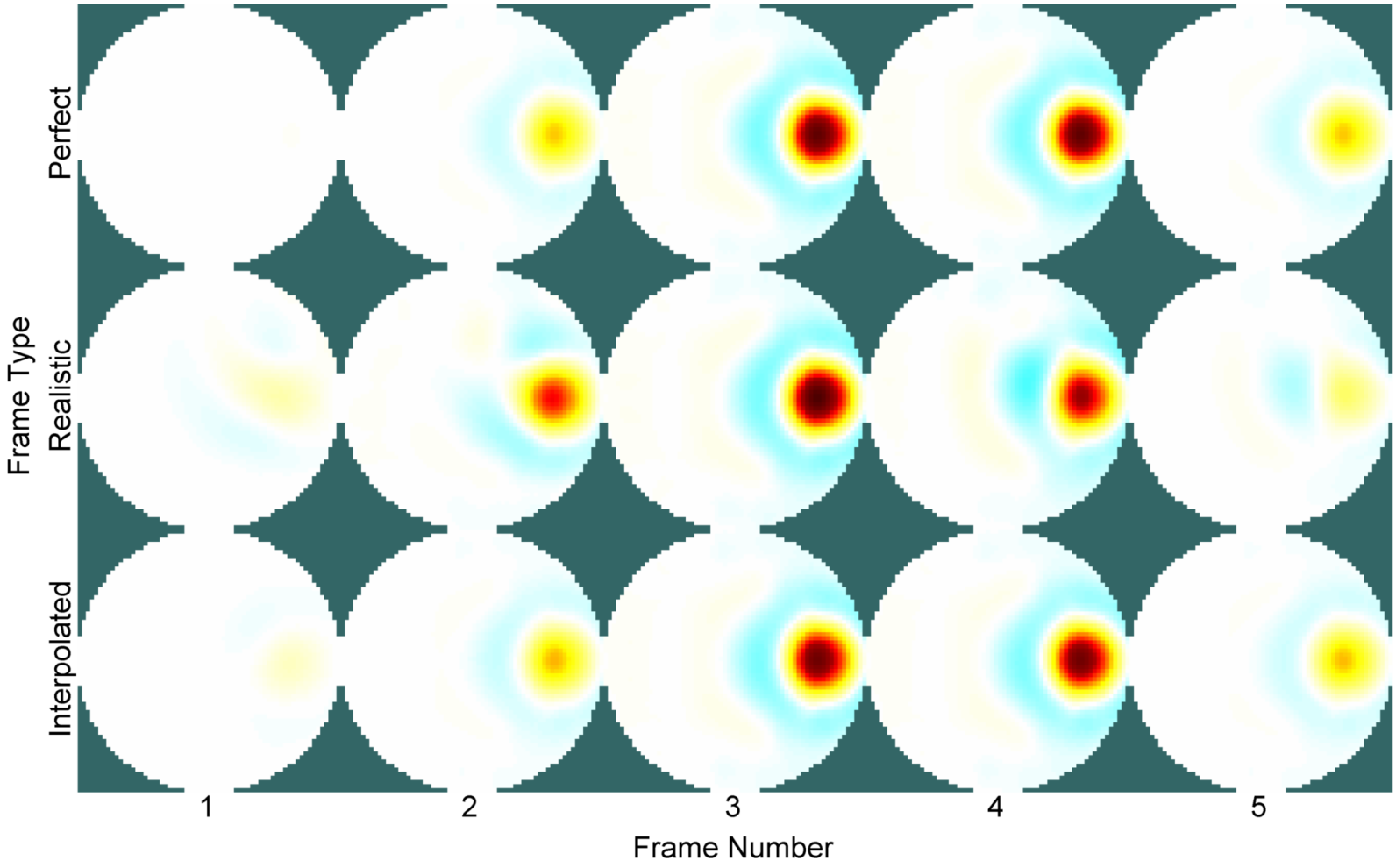
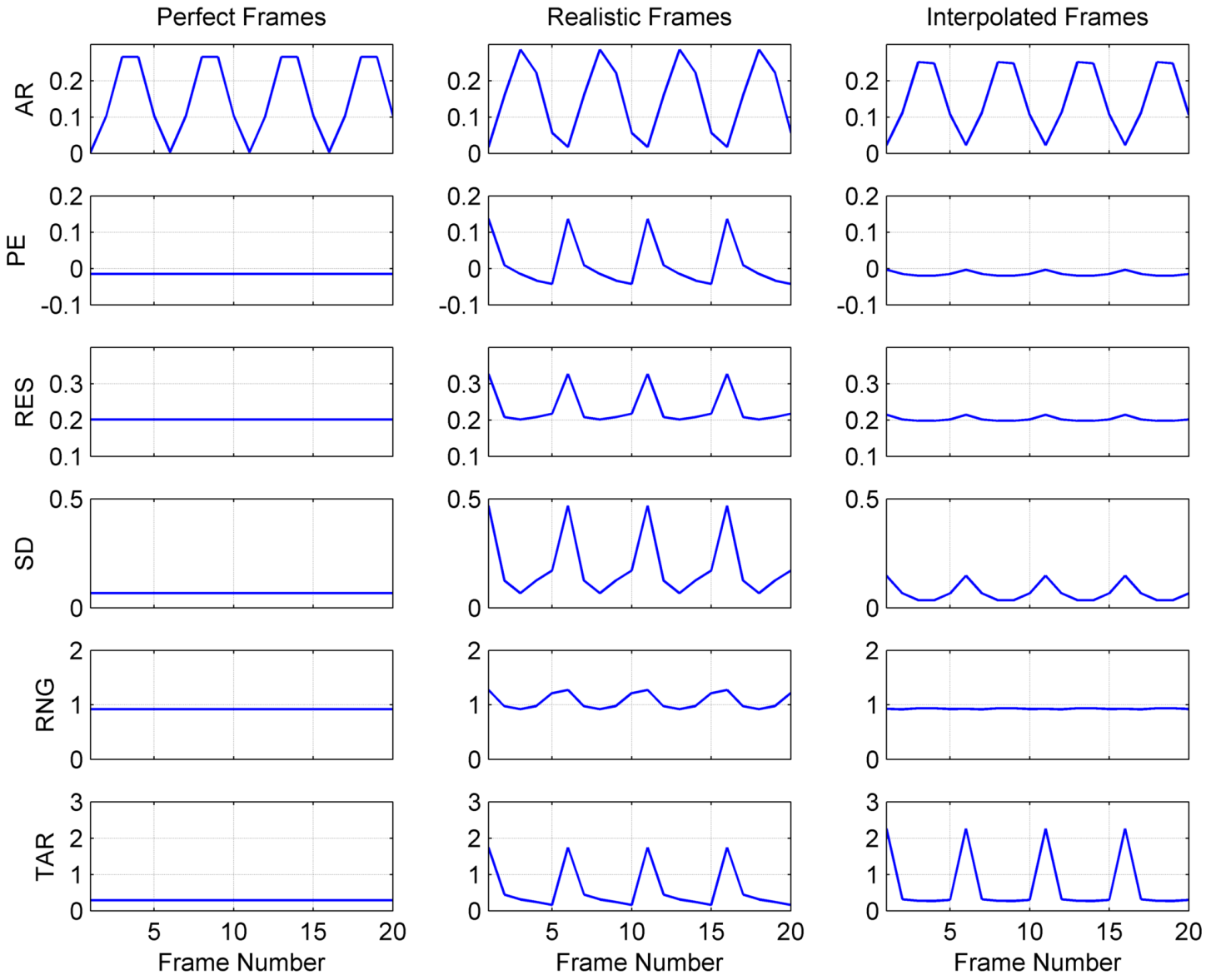


FOM as a function of time

- Introduction
- Methods
- **Results**
- Discussion and Conclusion



FOM as a function of frequency

- Introduction
- Methods
- **Results**
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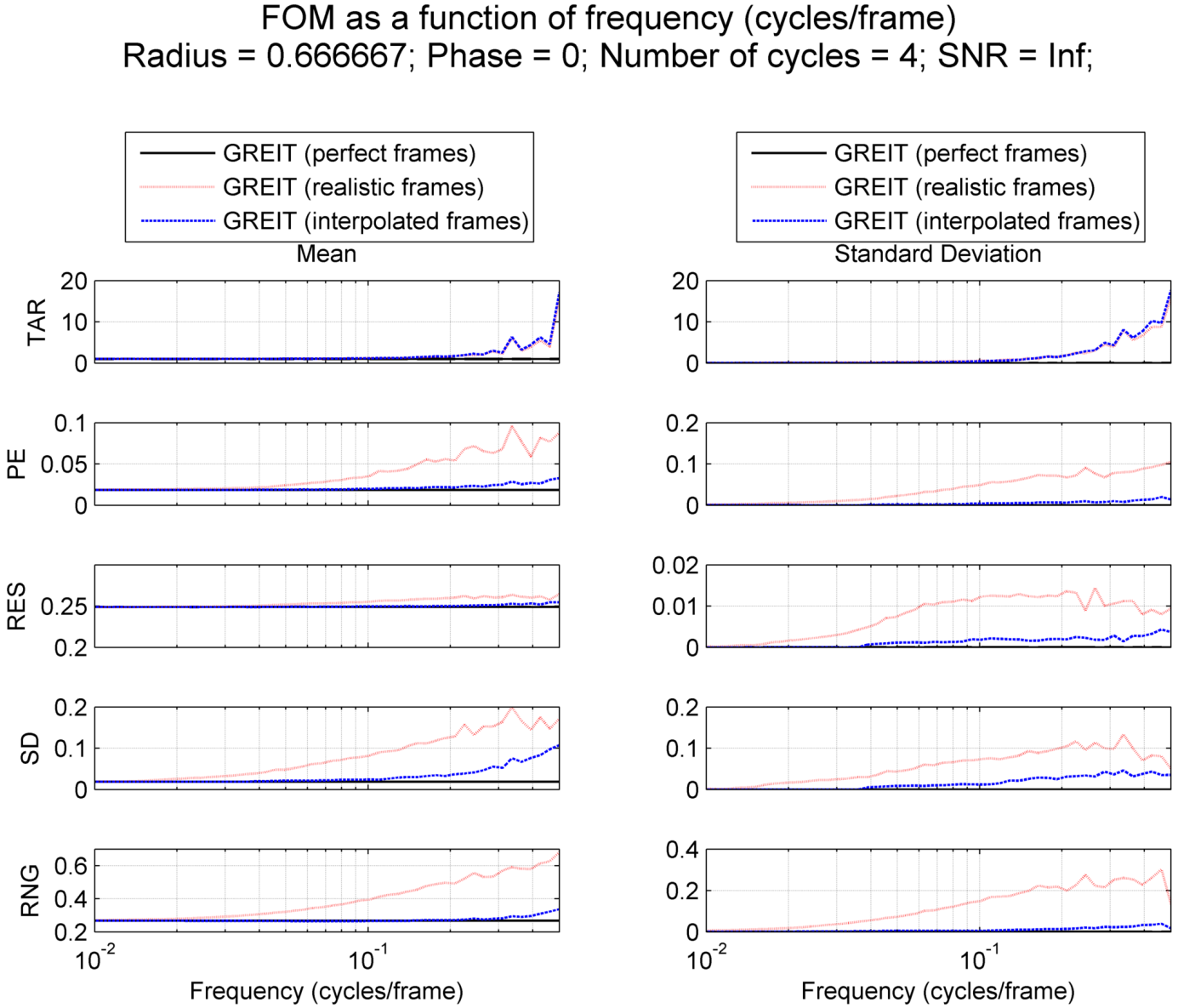

Conclusion

- Temporal artefacts and FOM worsening observed as low as 50× below frame rate.
- No clear winner among the proposed techniques to account for temporal effects.
  - The performance of most algorithms could be optimized for particular scenarios.
- The proposed framework is useful for:
  - Observing temporal effects and artefacts;
  - Designing the next generation of algorithms accounting for temporal effects.

Thank you!

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