

# Paper + some CBC results

Mark Blyth

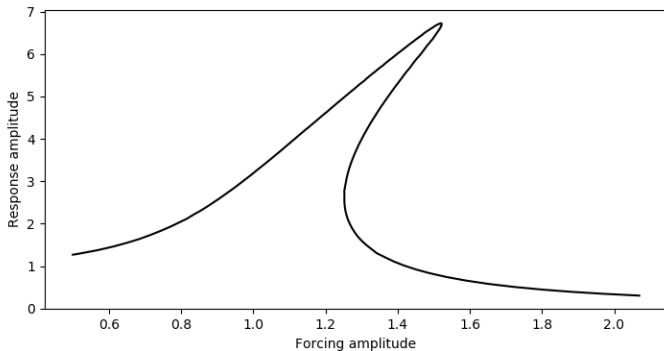
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## Week's goal

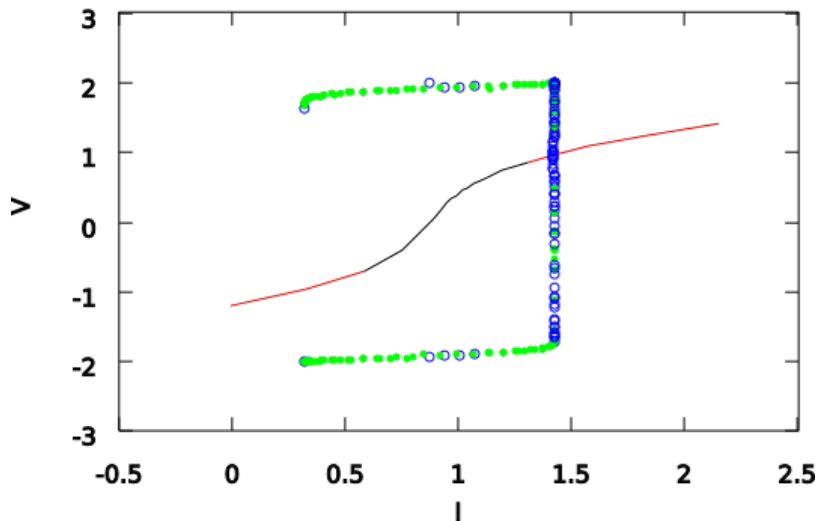
- ✶ Play with in-silico CBC
- ✶ Write conference paper

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## Fourier, Duffing



## XPP Fitzhugh-Nagumo



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## Modified Fitzhugh-Nagumo model

### Original

$$\dot{v} = v - v^3/3 - w + I \quad (1)$$

$$\dot{w} = 0.08(v + 0.7 - 0.8w) \quad (2)$$

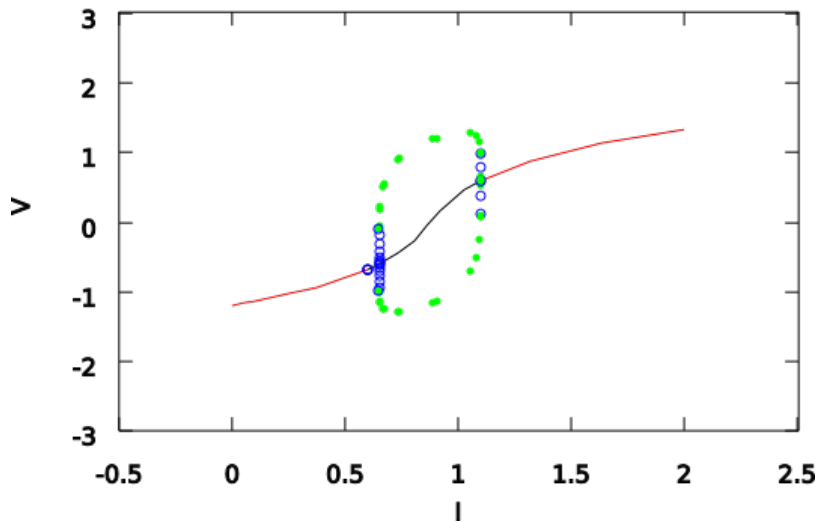
### New

$$\dot{v} = v - v^3/3 - w + I \quad (3)$$

$$\dot{w} = 0.8(v + 0.7 - 0.8w) \quad (4)$$

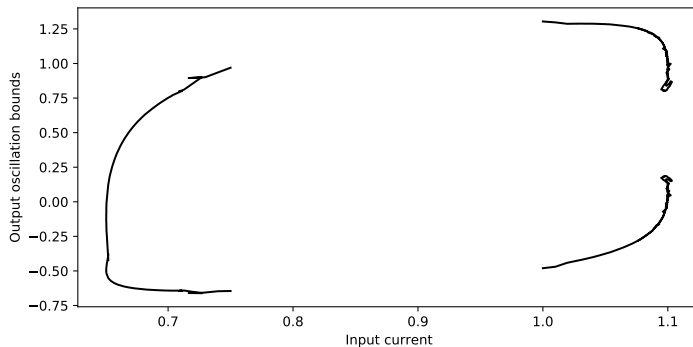
- ✂ Changed timescale separation
- ✂ 'Widens out' Canard explosion
- ✂ Makes signal less nonlinear, more readily described with Fourier

## XPP modified



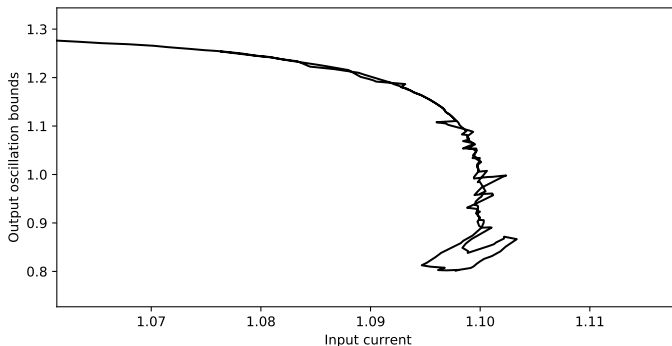
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## Modified Fitzhugh-Nagumo CBC



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## Modified Fitzhugh-Nagumo CBC





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## CBC progress

DONE:

✶ IO-map method for (harmonically forced) Duffing, Fourier discretisation

TODOS:

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## CBC progress

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- ✦ IO-map method for (harmonically forced) Duffing, Fourier discretisation
  - ▶ No phase constraint; signal period taken from forcing parameter

TODOs:

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### TODOs:

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  - ▶ Phase constraint; signal period treated as continuation parameter

### TODOs:

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### TODOs:

- ✦ CBC with splines discretisation

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- ✂ CBC using the 'other' (non-IO-map) method

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### TODOs:

- ✂ CBC with splines discretisation
- ✂ CBC using the 'other' (non-IO-map) method
- ✂ CBC on the equilibrium

# Conference paper

Currently drafted:

- ✂ Intro
- ✂ Maths behind CBC, plus motivation of discretisation
- ✂ Novel discretisation methods

TODOs:

- ✂ Surrogate models as adaptive filters for cleaner Fourier discretisation
- ✂ Usage cases of surrogates, novel discretisers
  - ▶ Might merge with conclusion or intro
- ✂ Conclusion
- ✂ Figures
- ✂ Proof-reading / editing / re-drafting



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## Next steps

1. Write paper
  - ▶ Goal: finish text by Friday
2. Generate figs for paper
  - ▶ Splines vs. Fourier: goodness-of-fit vs. dimensionality of discretisation
  - ▶ Splines vs. Fourier: noise-robustness
  - ▶ Plus any figs for the surrogates section
3. Proof read, re-draft, edit paper
4. Implement a splines-based CBC
  - ▶ Not essential, but paper would benefit from saying we've done it
  - ▶ Best to get a completed paper first, then start on this