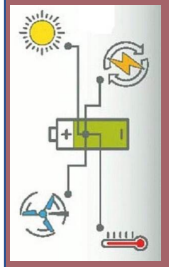
ICAEHT-2021

INTERNATIONAL CONFERENCE ON ADVANCES IN ENERGY HARVESTING TECHNOLOGY



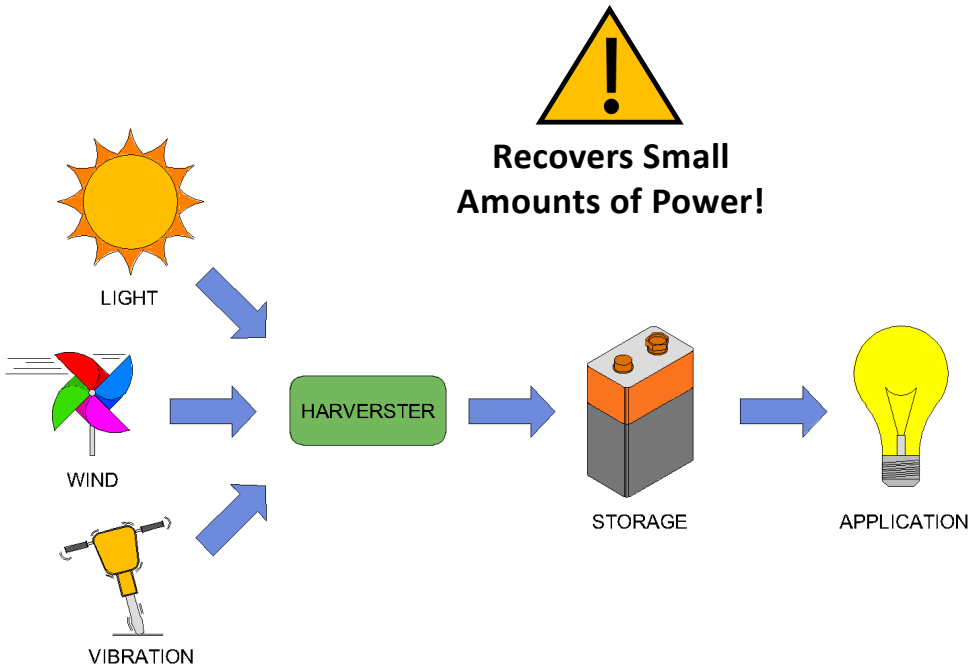
ON THE BIFURCATION ANALYSIS OF A BISTABLE PIEZO-MAGNETO-ELASTIC ENERGY HARVESTER

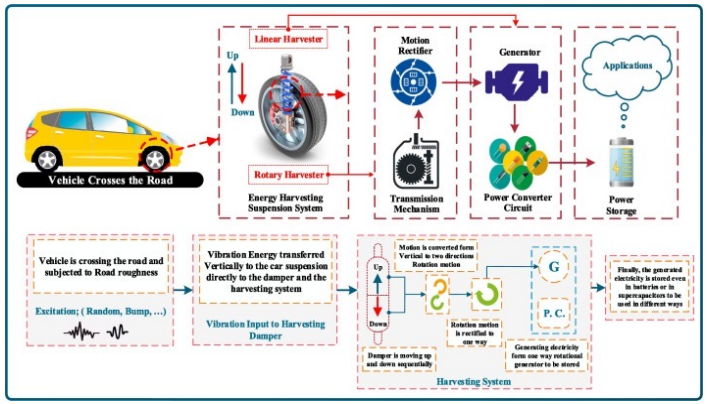
Vinicius Lopes, Americo Cunha

Rio de Janeiro State University (UERJ)

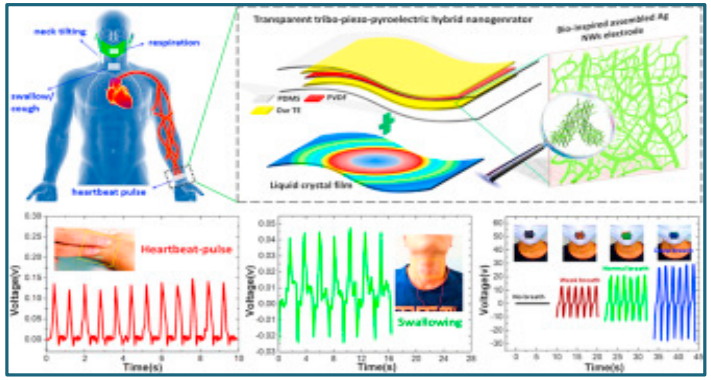
ONLINE, MARCH 18-20, 2021

The Harvesting Concept



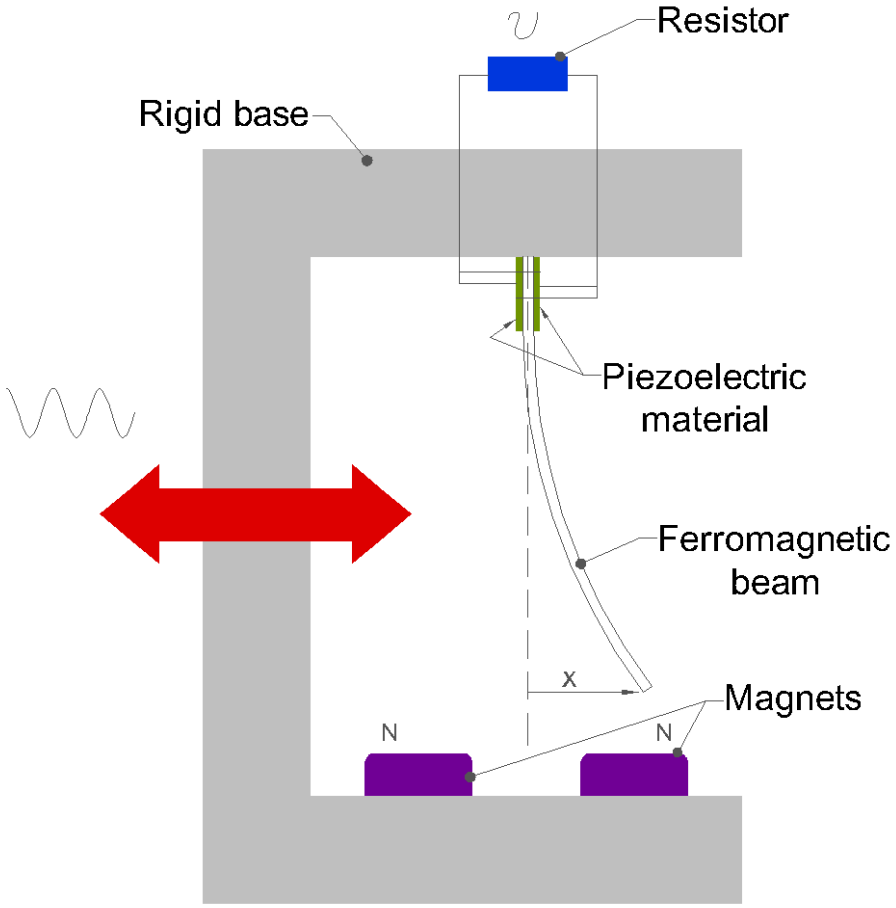


M. A. A. Abdelkareem et al, Vibration energy harvesting in automotive suspension system: A detailed review, In: Applied Energy, 229, 2018 (https://doi.org/10.1016/j.apenergy.2018.08.030)



J. Sun and T. Yang and C. Wang and L. Chen, A flexible transparent one-structure tribo-piezopyroelectric hybrid energy generator based on bio-inspired silver nanowires network for biomechanical energy harvesting and physiological monitoring, In: Nano Energy, 48, 2018 (https://doi.org/10.1016/j.nanoen.2018.03.071)

The Energy Harvester



Damping ratio

Forcing amplitude

Excitation frequency

$$\ddot{x} + 2\xi\dot{x} - 0.5x(1 - x^2) - \chi v = f\cos\Omega t$$

$$v + \lambda v + \kappa\dot{x} = 0$$

Piezoelectric coupling terms

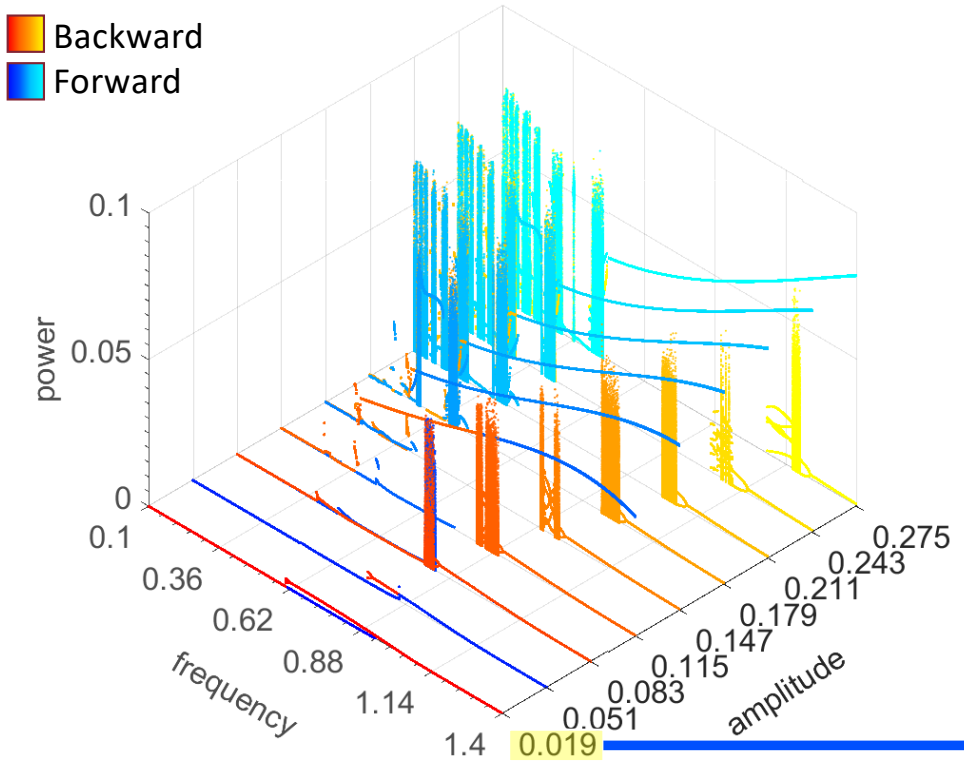
Reciprocal time constant

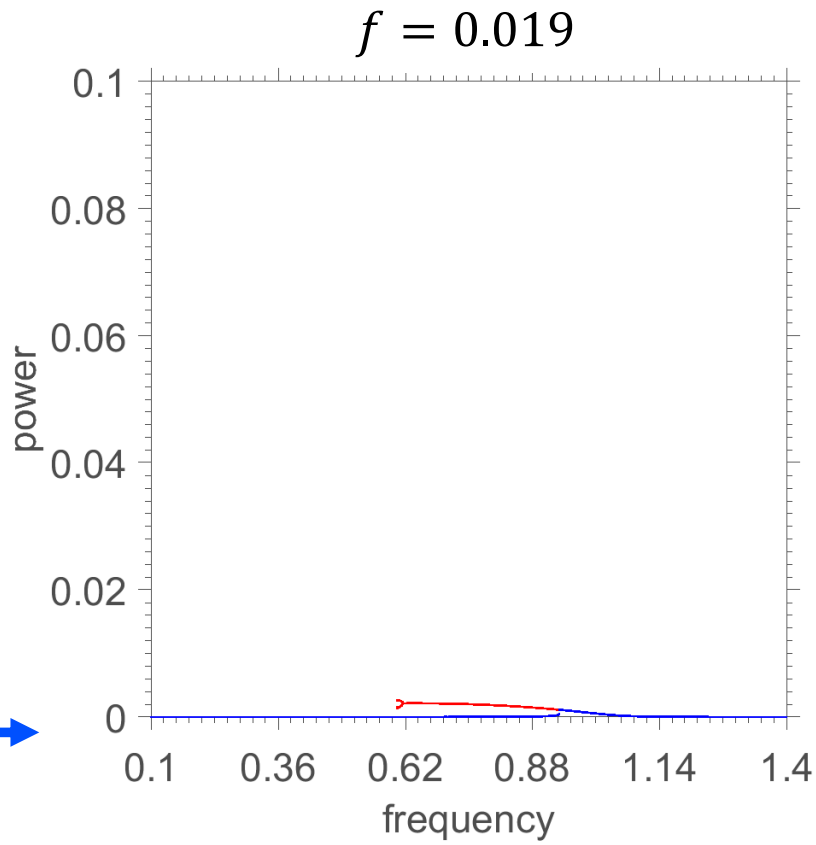
+ initial conditions

Recovered power:

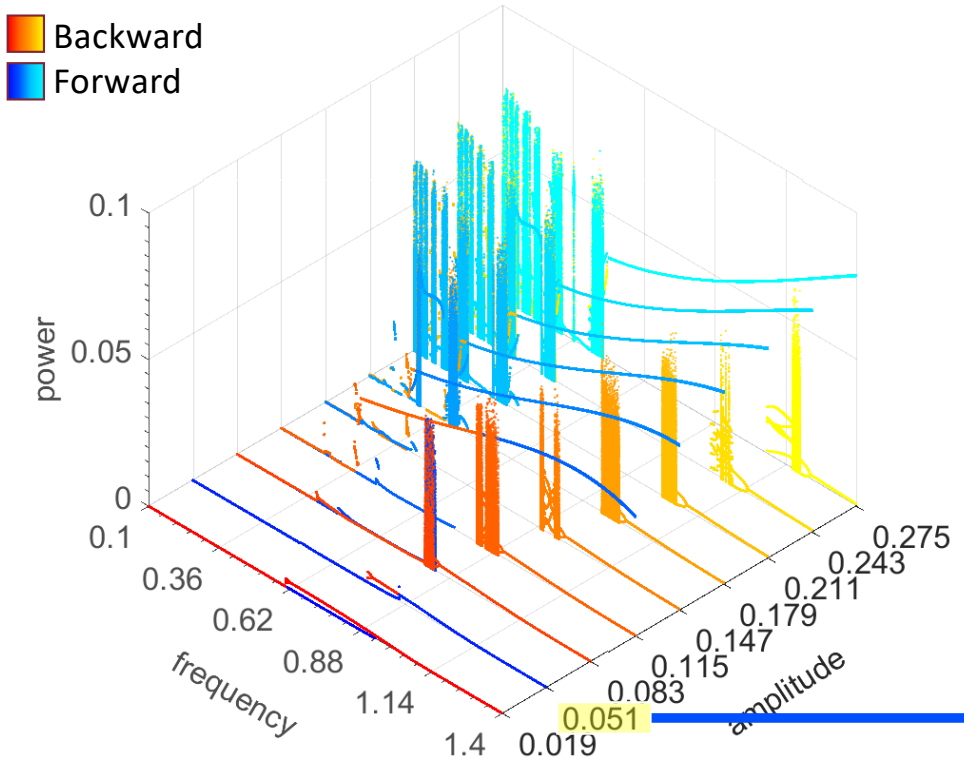
$$p(t) = \lambda v^2(t)$$

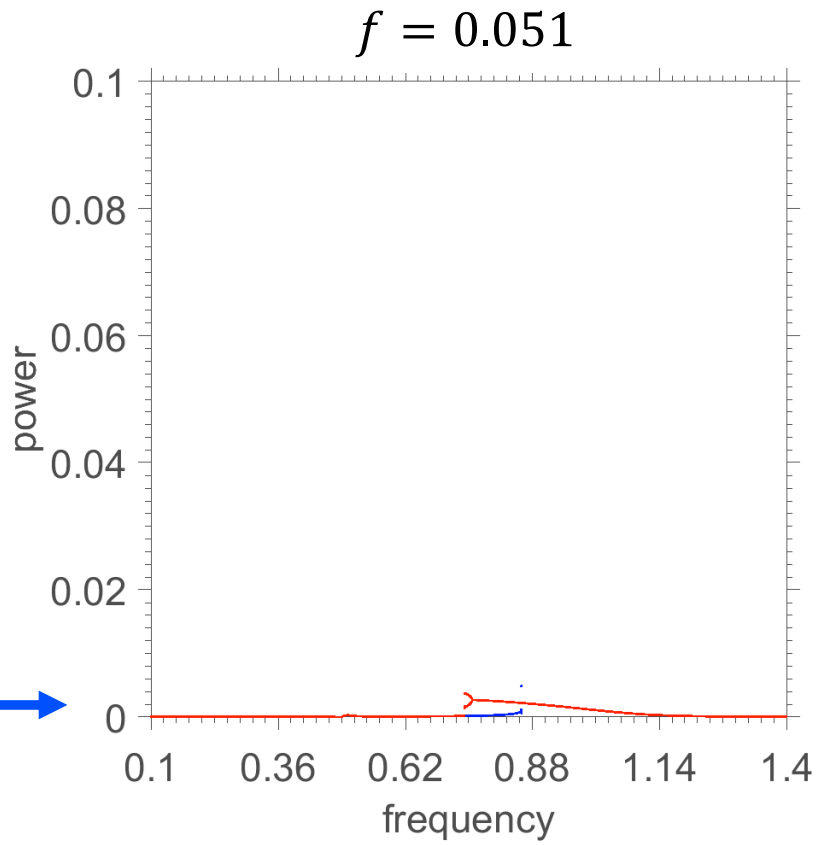
Excitation Frequency Power Bifurcation Diagrams



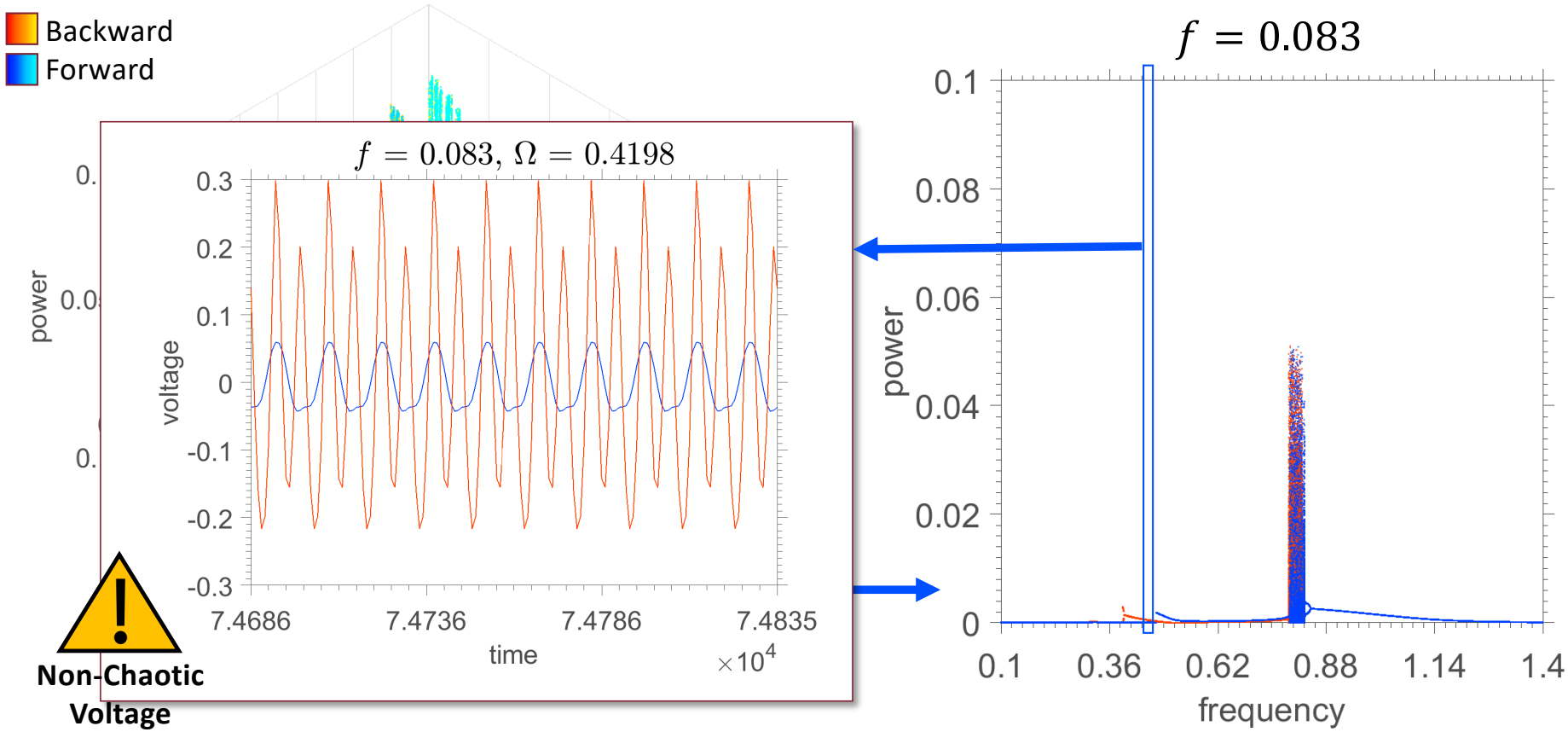


Excitation Frequency Power Bifurcation Diagrams

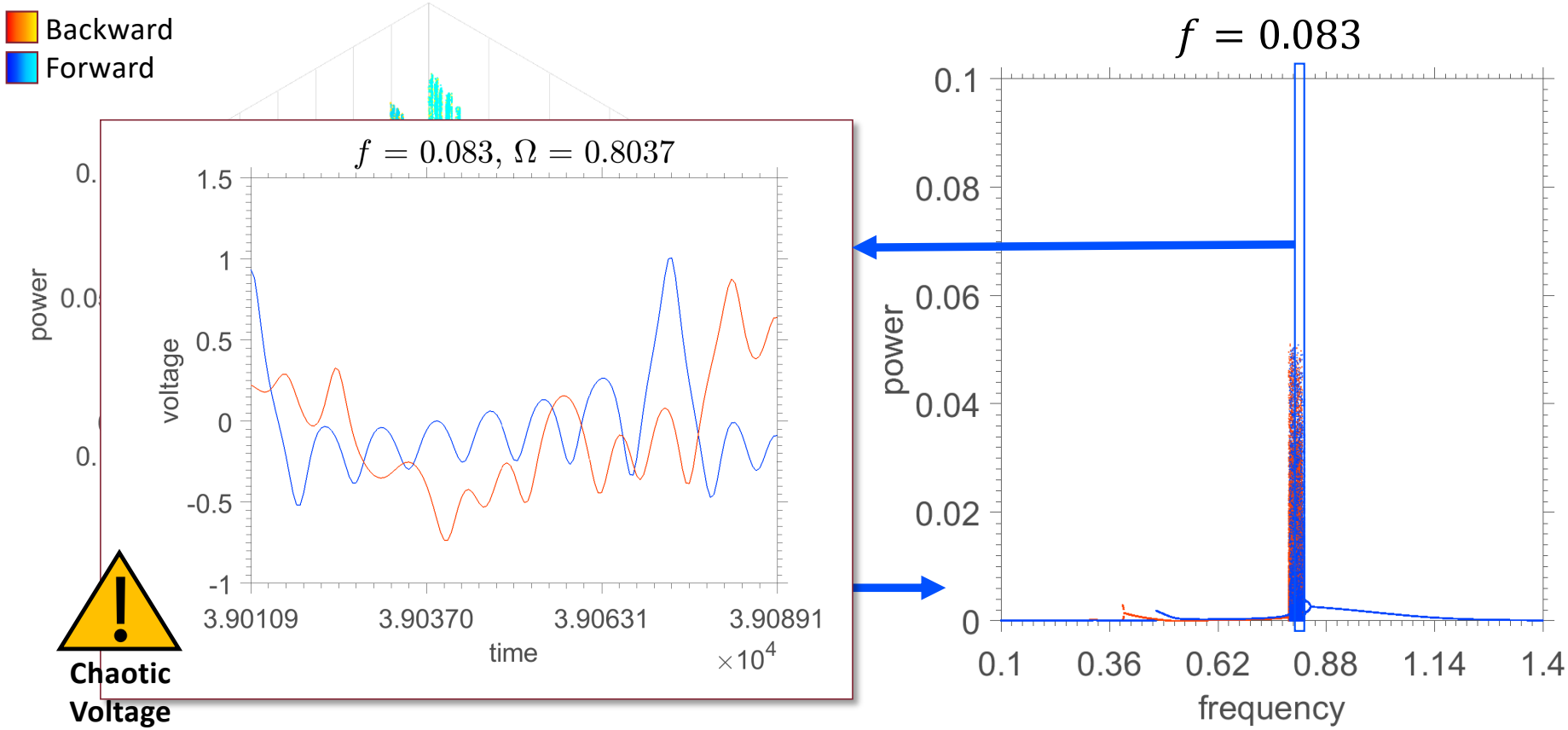




Excitation Frequency Power Bifurcation Diagrams

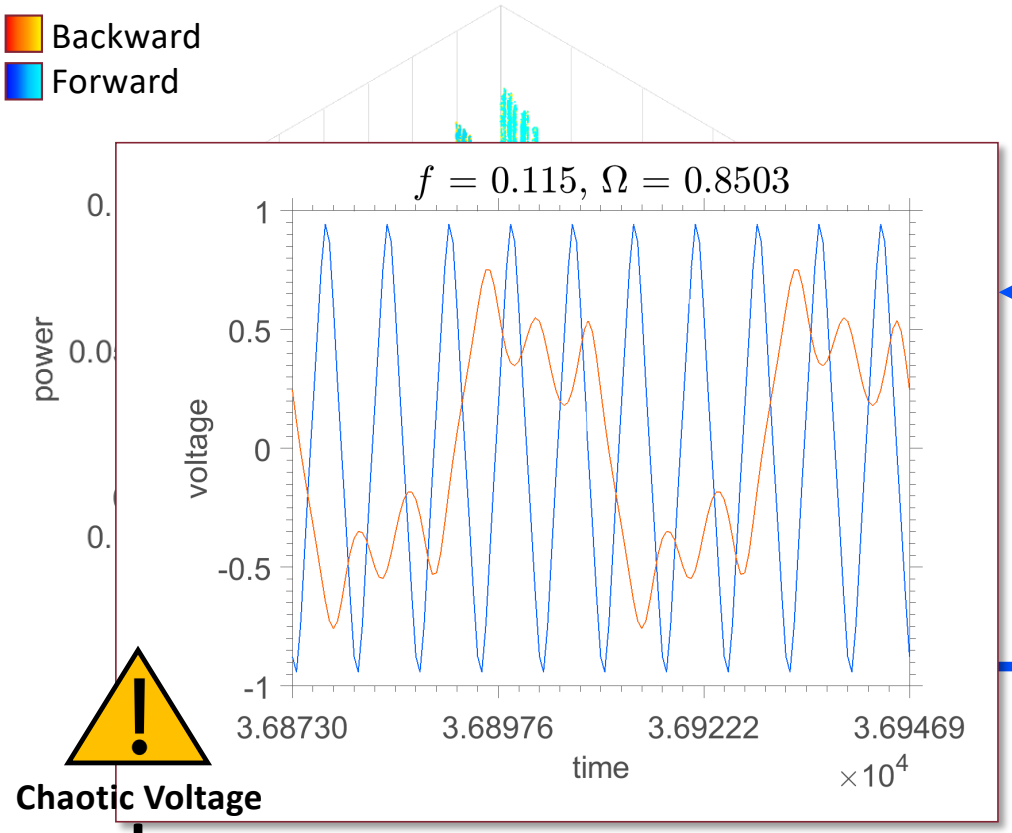


Excitation Frequency Power Bifurcation Diagrams



Excitation Frequency Power Bifurcation Diagrams

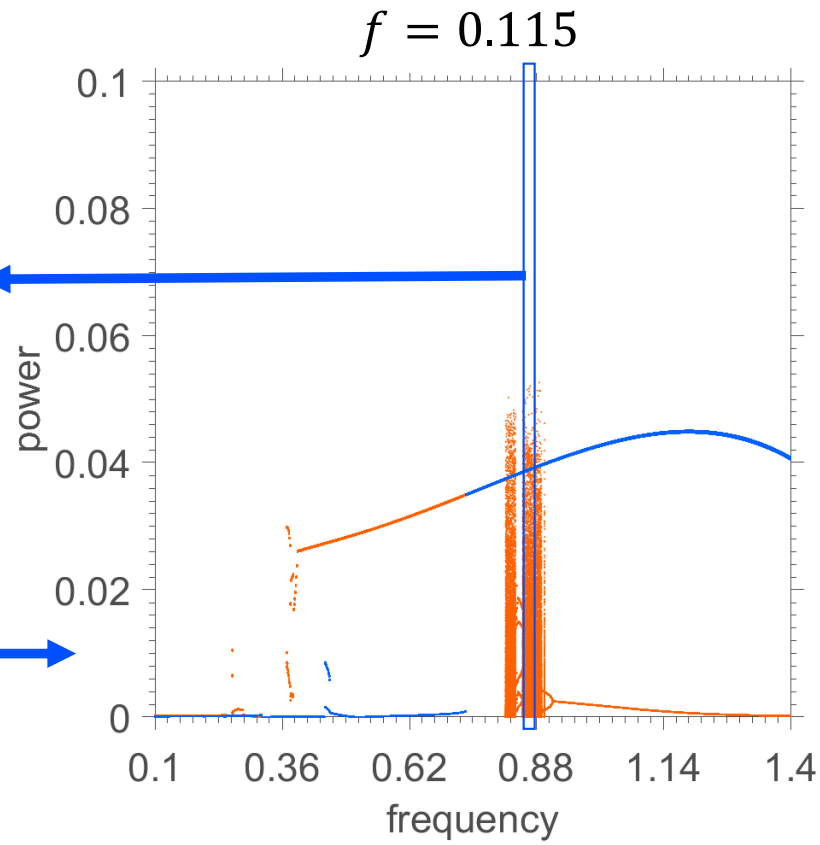
Backward
Forward



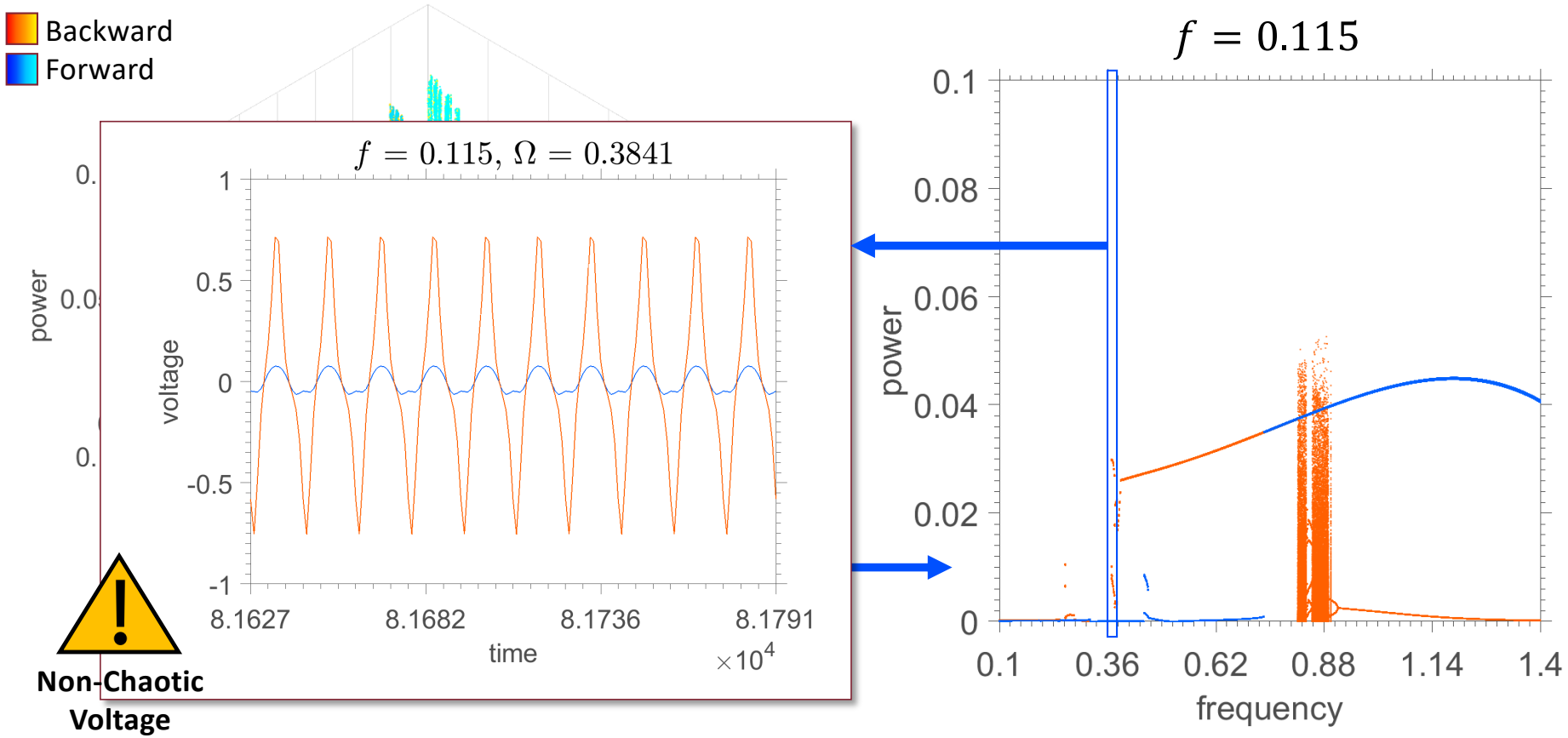
Chaotic Voltage

+

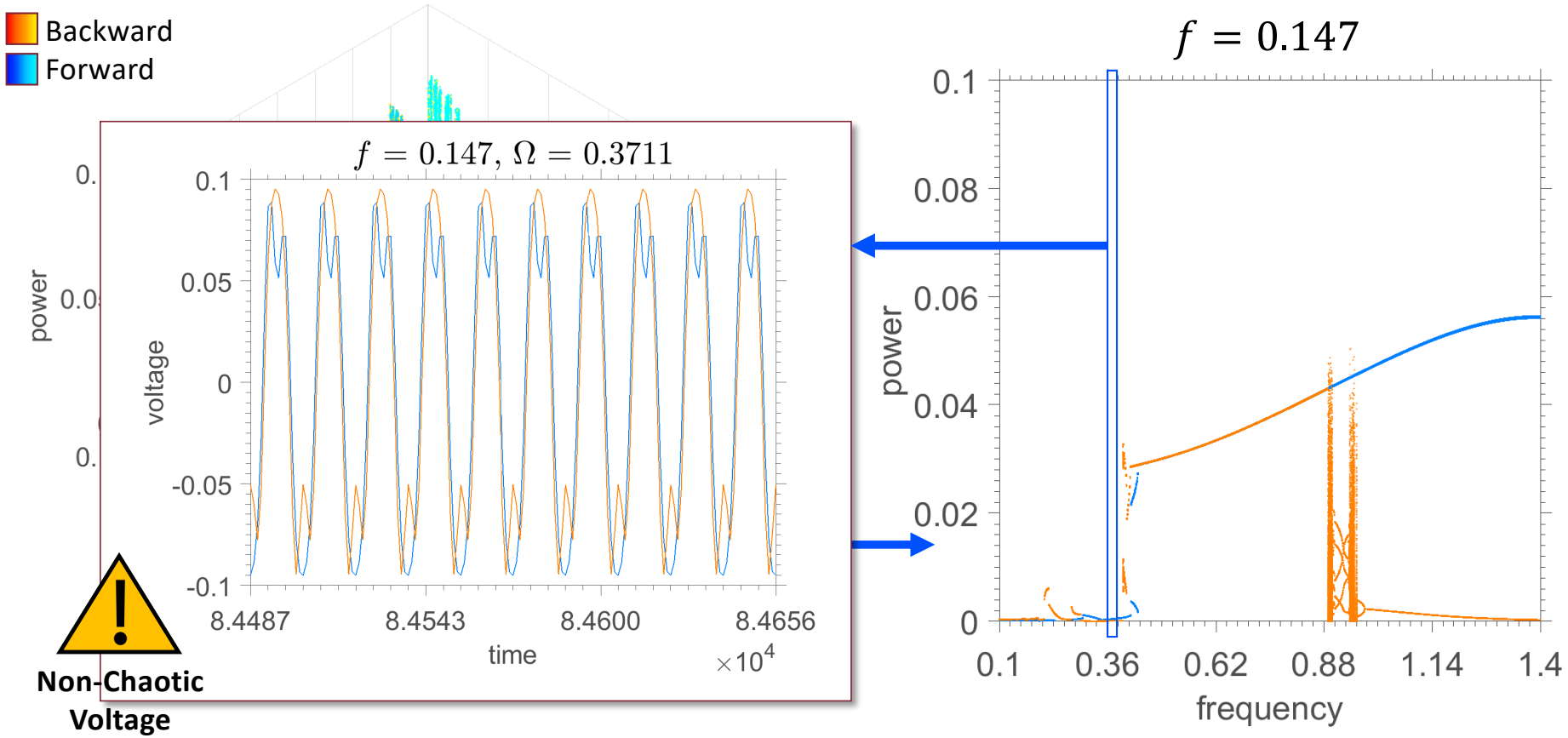
Hysteresis Effect



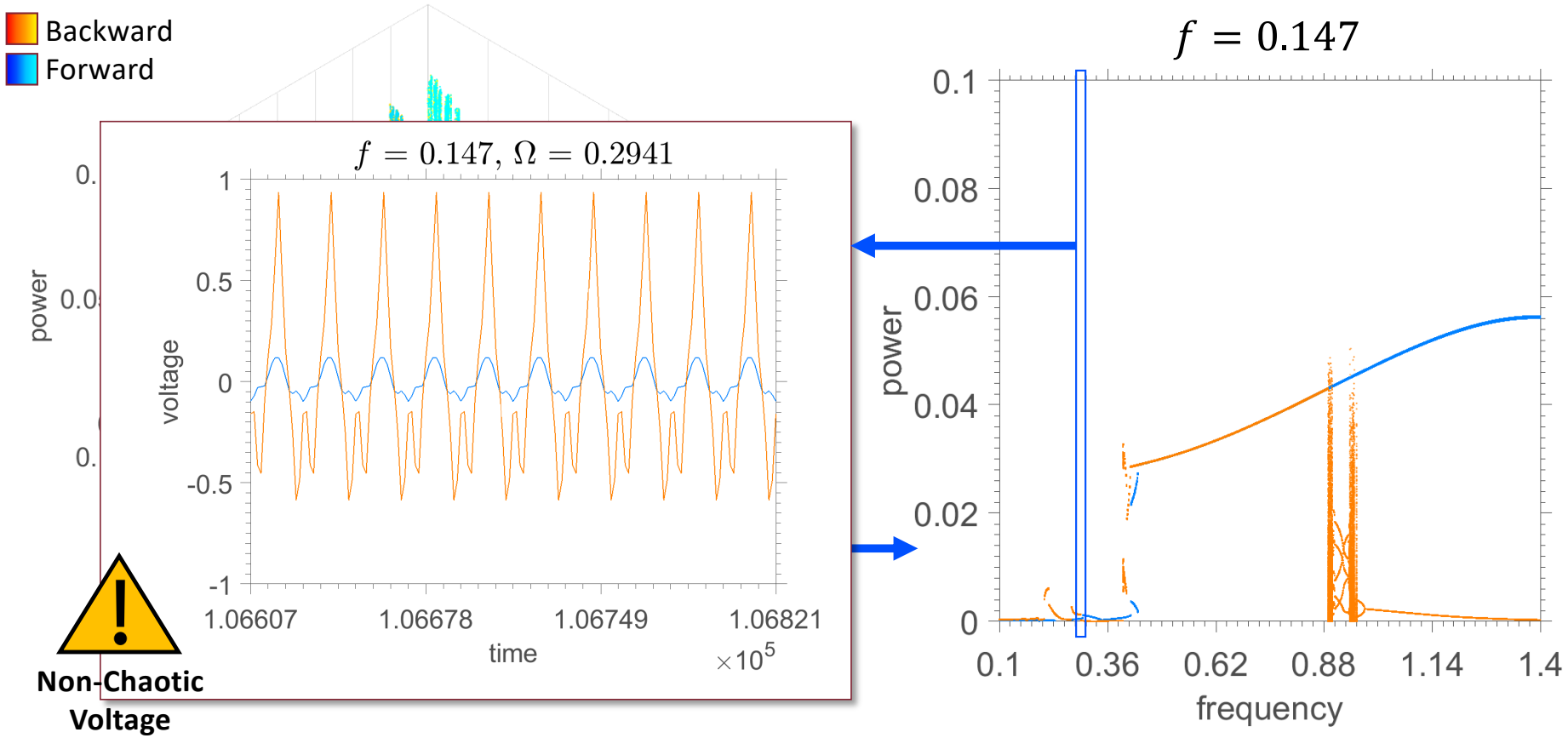
Excitation Frequency Power Bifurcation Diagrams



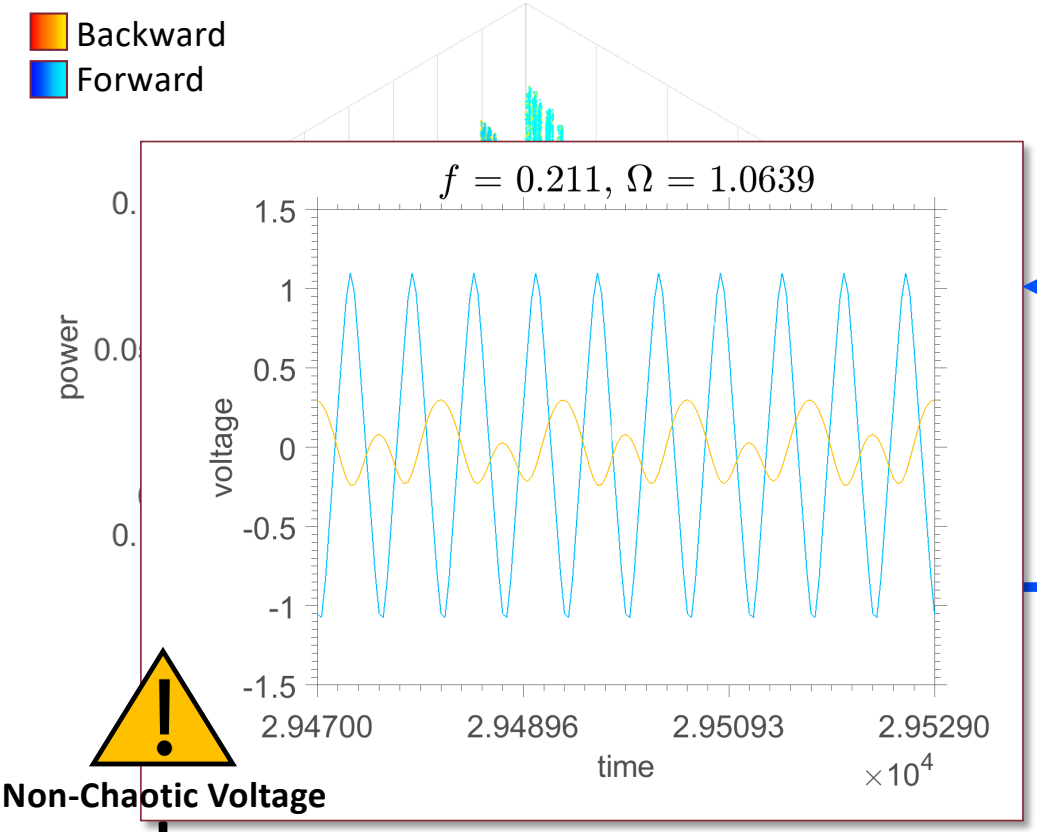
Excitation Frequency Power Bifurcation Diagrams

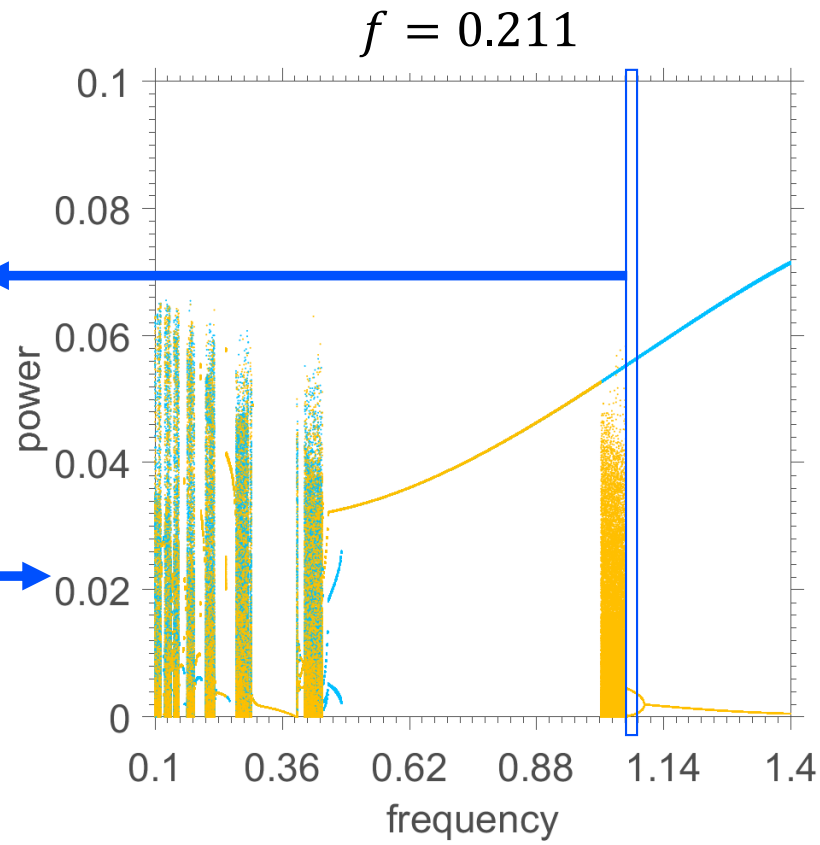


Excitation Frequency Power Bifurcation Diagrams



Excitation Frequency Power Bifurcation Diagrams



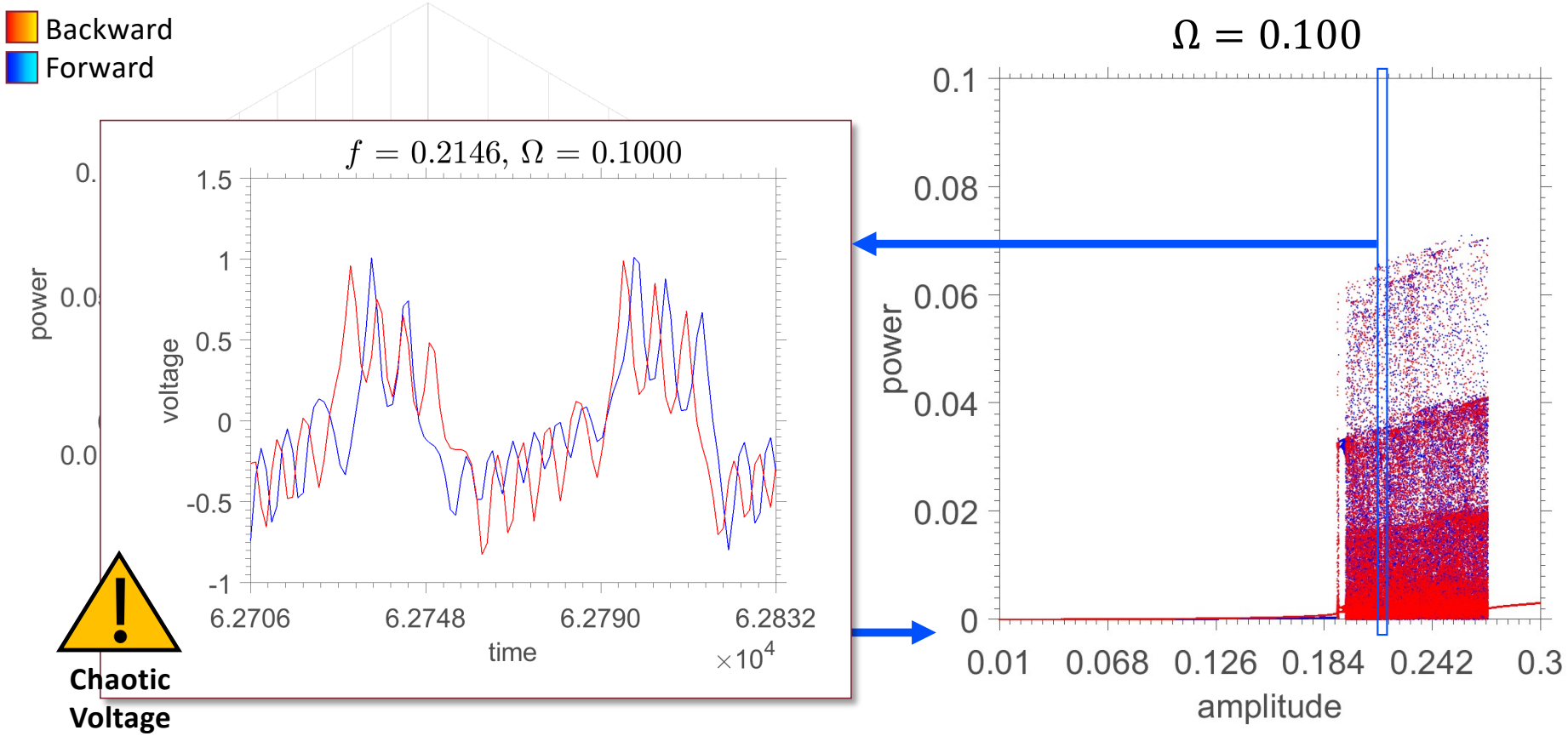


Non-Chaotic Voltage

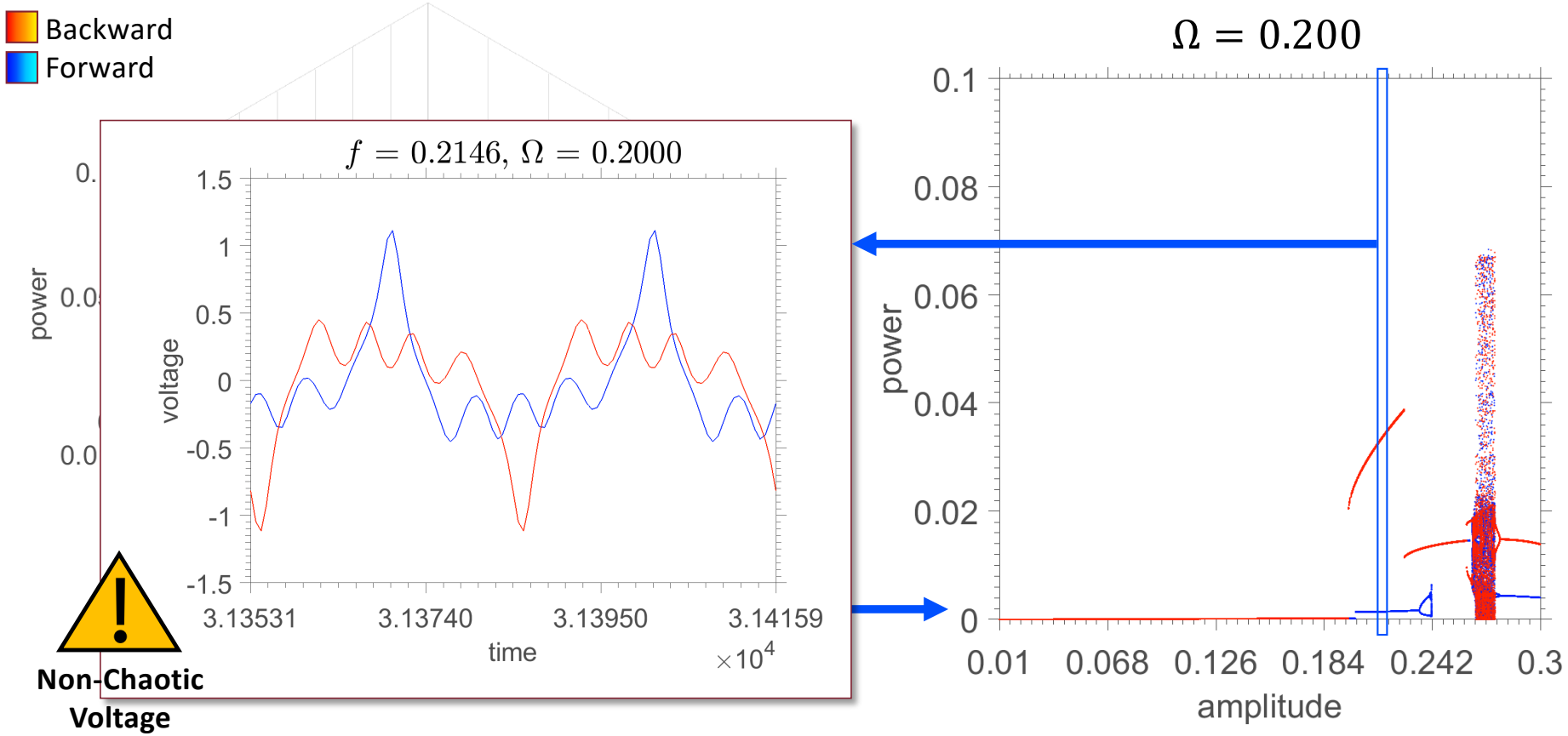
+

Hysteresis Effect

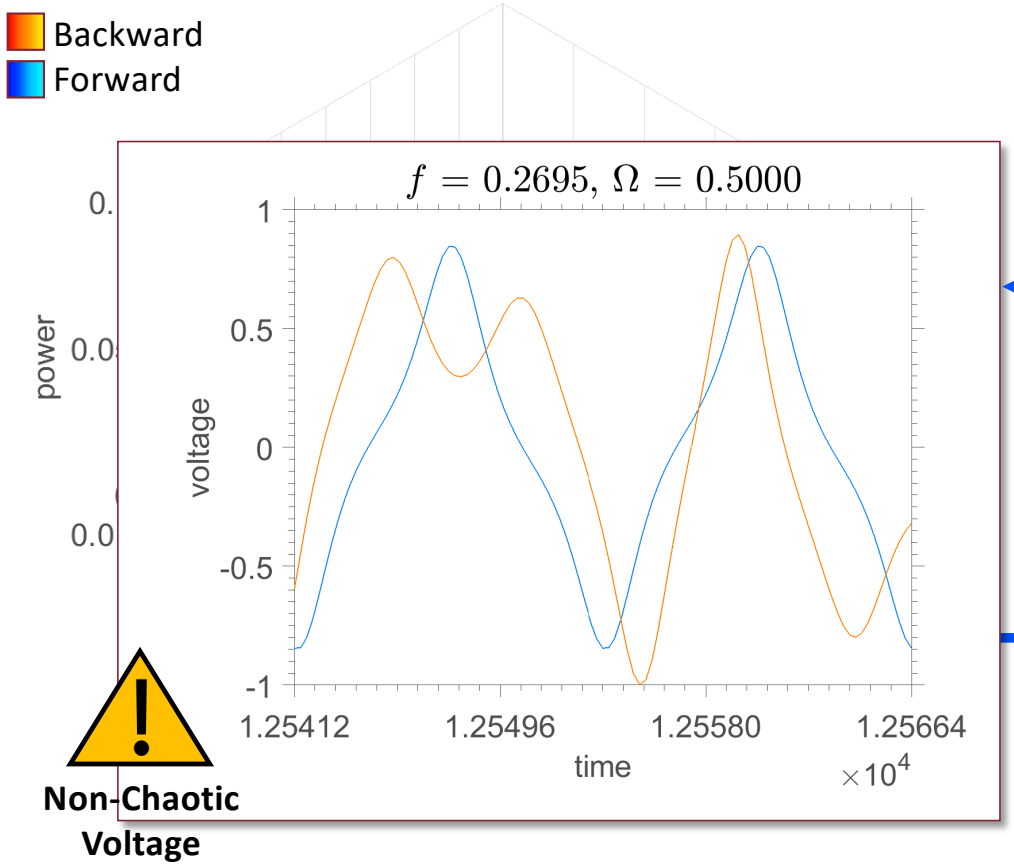
ICAEHT-2021 Forcing Amplitude Power Bifurcation Diagrams

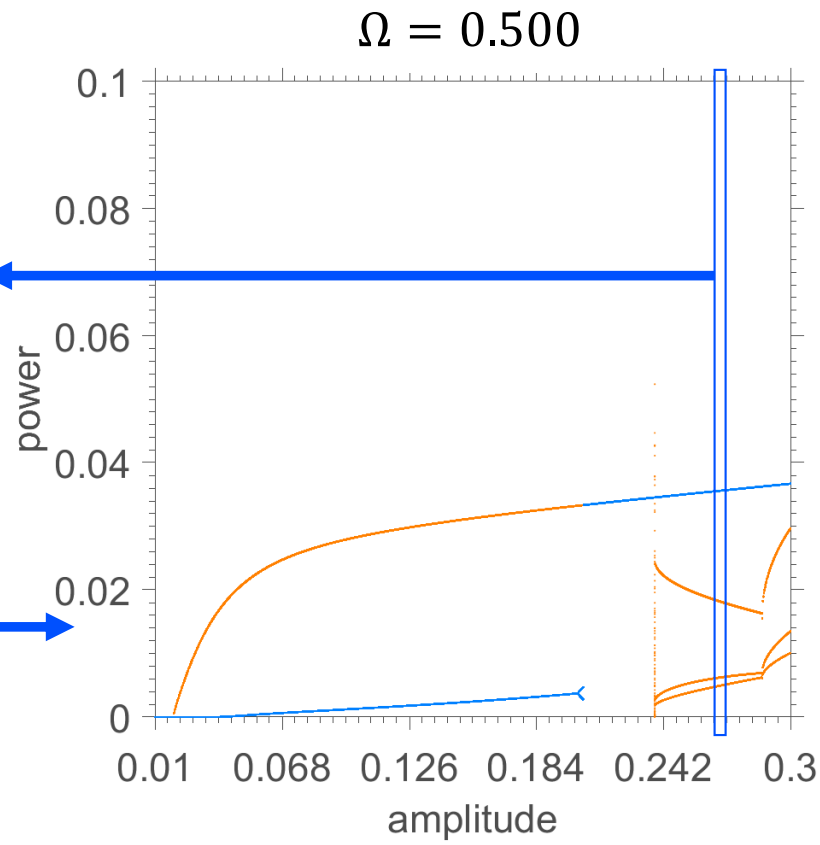


ICAEHT-2021 Forcing Amplitude Power Bifurcation Diagrams



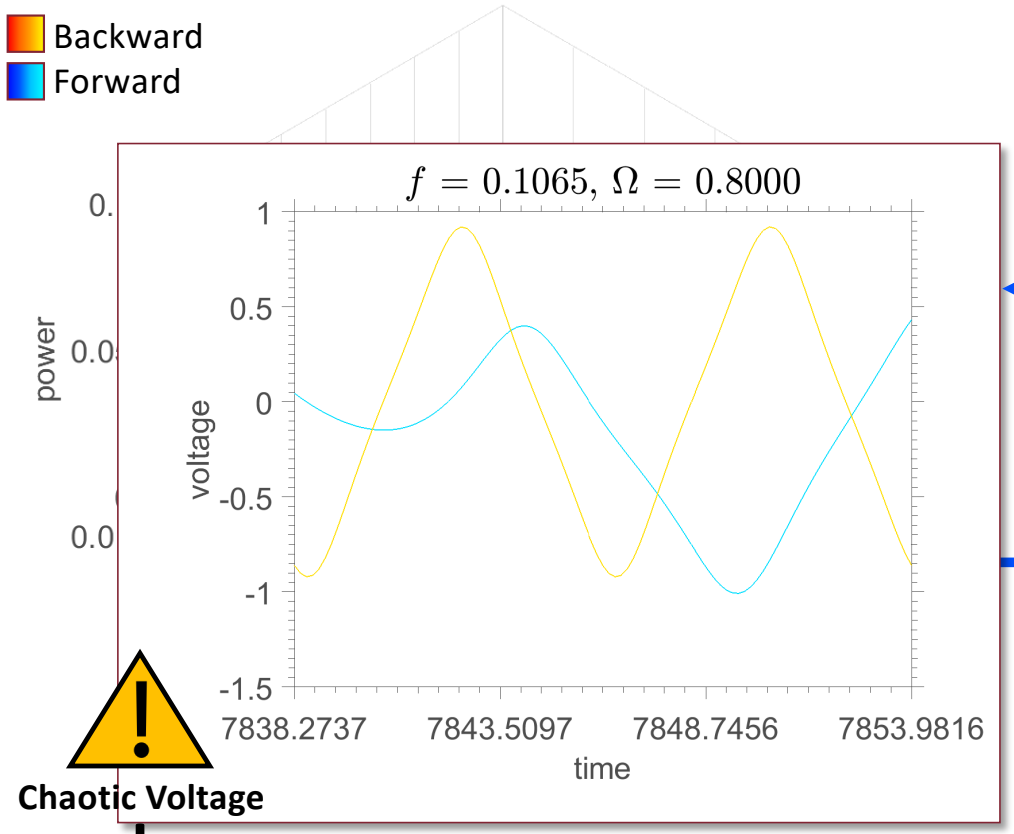
ICAEHT-2021 Forcing Amplitude Power Bifurcation Diagrams





ICAEHT-2021 Forcing Amplitude Power Bifurcation Diagrams

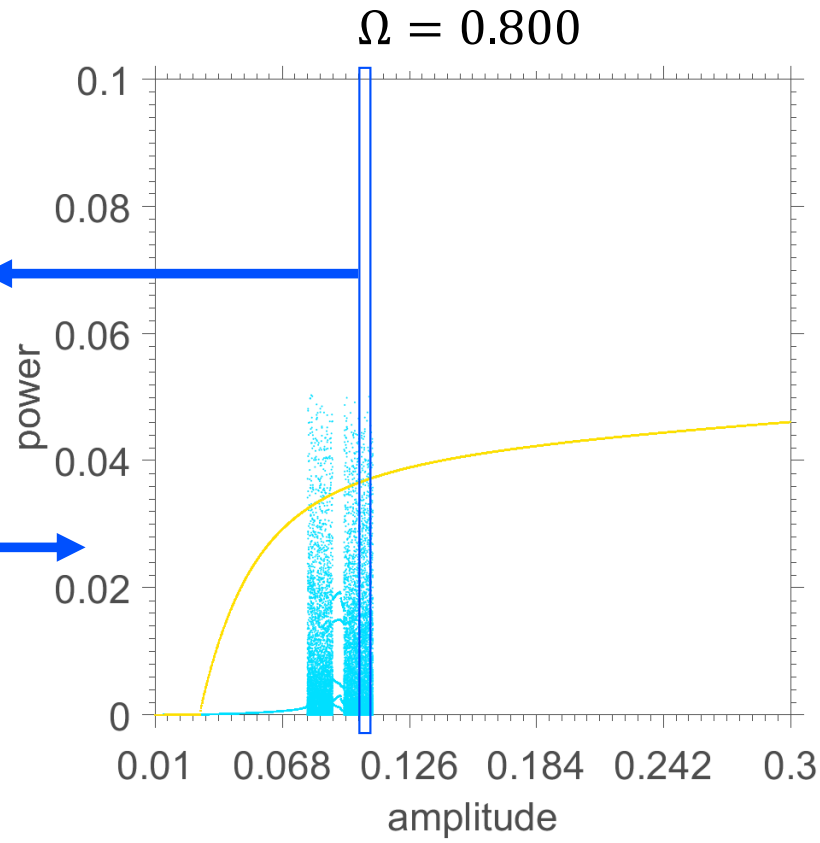
Backward
Forward



Chaotic Voltage

+

Hysteresis Effect



Main Conclusions

- Bifurcation analysis allows to map chaotic disturbances regions on device dynamics;
- Excitation frequency and forcing amplitude may be explored to provide best power recovering performances;
- System previous state determines the current chaotic/regular response (forcing ordering matters);

ICAEHT-2021

INTERNATIONAL CONFERENCE ON ADVANCES IN ENERGY HARVESTING TECHNOLOGY

Thank you! ☺

Vinicius Lopes (vinigolop@outlook.com)

Americo Cunha (americo@ime.uerj.br)