# Heart stroke-volume variability in a murine model for heart failure with reduced ejection fraction

Gemma Fernández-Mendoza*

*Departamento de Física, Escuela Superior de Física y Matemáticas, Instituto Politécnico Nacional, 07738 Ciudad de México, México*

Moisés Santillán†

*Centro de Investigación y de Estudios Avanzados, Unidad Monterrey, 66628 Apodaca NL, México*

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# Abstract

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## I. INTRODUCTION

## II. MATERIALS AND METHODS

## III. RESULTS

### A. Experimental Results

### B. Variability analysis

Heart rate variability has been measured using a variety of techniques. The majority of them are based on the notion of signal stationarity. However, the heart rate's inherently non-stationary nature—which undergoes continuous physiological change to adapt to outside stimuli—presents a significant challenge that could lead to inaccurate results [1]. Although a number of signal preprocessing methodologies have been suggested to address these problems, nonlinear analysis-based strategies are frequently used and seem to produce reliable result [1–7]. One of them that is used in different scientific domains is the Poincairé plot [6, 8], which has numerous applications in different scientific domains [9]. In a Poincairé plot, all values of a time series are plotted against previous values, leading to an ellipsoidal point cloud. Moreover, this diagram may be analyzed quantitatively by the standard deviations of the point projections along the lines $y = x$ (SD2) and $y = -x$ (SD1). The transverse axis of the ellipse (SD1) is a measure of the short-term changes in the the time series, while the longitudinal axis (SD2) reflects long-term changes. In the particular case of heart-beat duration time-series, SD1 is considered as an indicator of the parasympathetic activity, whereas SD2 is considered as an inverse indicator of the sympathetic activity [10].


* gemmag.fernandez@gmail.com

† http://moises-santillan.github.io; msantillan@cinvestav.mx

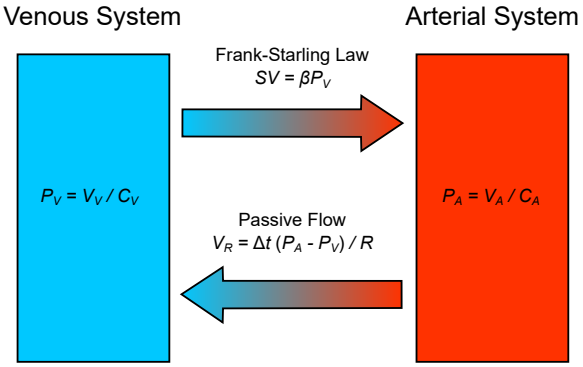


FIG. 1. Schematic representation of the model

### C. Mathematical Model

## IV. CONCLUDING REMARKS


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