

# DIFFERENT PARADIGMS FOR SOLVING NONLINEAR LEAST-SQUARES REGRESSION PROBLEM

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**Abstract** – This paper shows different methods for solving a nonlinear regression problem. It is used a dataset with 250 observations of a nonlinear system with one input and one output variable. For the correct characterization of the processes, it is used the least-squares regressor by parts, a  $k$ th order polynomial regressor, a Mamdani fuzzy infer system and a 0-order Takagi-Sugeno fuzzy system. All models are analyzed via  $R^2$  considering various structures (polynomial order, number of intervals, etc...), and the residues and the scatter plots of the best solutions are analyzed and discussed.

**Keywords** – Nonlinear regression problem, Mamdani fuzzy system, Takagi-Sugeno fuzzy system, polynomial regressor, regression by parts.

## NOMENCLATURE

$P$	Number of poles.
$V_{qd}$	Stator voltage $dq$ components.
$I_{qd}$	Stator current $dq$ components.

## I. INTRODUCTION

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If relevant, a Nomenclature section may be included immediately before the Introduction, with a list of variables used in the text. This item should not contain reference numeration, as well as items Acknowledgements, References and Biographies.

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2) *Page Format*: Set top and bottom margins to 25 mm, left margin to 18 mm and right margin to 12 mm. The column is 87 mm. The space between the two columns is 6 mm. Paragraph indentation is 4mm.

**TABLE I**  
**Type Sizes**

Size (Points)	Style		
	Normal	Bold	Italic
8	Table texts		
9	Figure captions		
10	Authors' affiliations; main text; references	Abstract text; keywords, table captions	Abstract title and keywords title
12	Authors' names		
14	Paper title		

## II. ORGANIZATION OF THE PAPER

This section presents the main issues for editing the manuscript.

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The papers that shall be published in the Brazilian Power Electronics Journal must contain the following main sections: 1) Title; 2) Authors and Affiliations; 3) Abstract and Keywords; 4) Introduction; 5) Body Text; 6) Conclusions; 7) References; 8) Biographies. This order must be respected, unless the authors add some items, such as: Nomenclature; Appendices and Acknowledgements.

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On the last page of the paper, the authors should distribute the contents evenly, using both columns, in a way that both end in a parallel manner.

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The organization of the manuscript in titles and subtitles is important to divide it in sections, which help the reader to find subjects of interest in the paper. They also help the authors to develop their paper in an orderly form. The paper can be organized in primary, secondary and tertiary sections.

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Figures also need captions and they are designated by Figure in the text (Fig. in the caption itself), numbered with Arabic numerals in a sequenced manner, left- and right-justified, as shown in the example. The designation of the parts of a figure is done by adding lowercase letters to the numbers of the figures starting with the letter a, e.g. Figure 1(a).

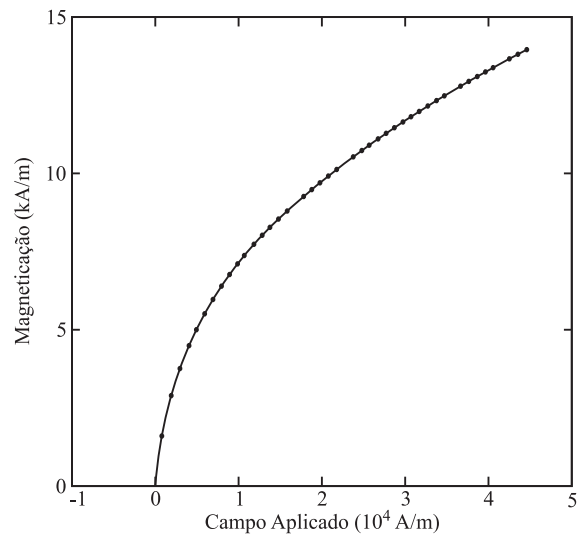


Fig. 1. Magnetization as a function of applied field. (Note that “Fig.” is abbreviated and there is a period after the figure number followed by two spaces.)

To better understand graphs, the definition of their axes should be done with words not letters, except when referring to waveforms and phase planes. The units should be between parentheses. For example, use the denomination “Magnetization (A/m)”, instead of “M (A/m)”.

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Number equations consecutively with equation numbers in parentheses flush with the right margin, as in (1). The equations should be written in a compact form, centered in the column. If a nomenclature section is not included in the beginning of the text, the quantities should be defined right

after the equation, such as:

$$\Delta I_L = I_o + \frac{\sqrt{3}}{2} \frac{V_i}{Z} \quad (1)$$

where:

- $\Delta I_L$  - resonant inductor peak current;
- $I_o$  - load current;
- $V_i$  - source voltage;
- $Z$  - characteristic impedance.

#### IV. CONCLUSIONS

This paper was fully written in accordance with the guidelines for submissions of papers in English.

#### ACKNOWLEDGEMENTS

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(xxyyzz process).

#### BIOGRAPHIES

**John Doe**, born in 02/30/1960 in Somewhere is an electrical engineer (1983), master (1985) and doctor in Electrical Engineer (1990) with the University of Y.

Between 1990 and 1995 he was the coordinator of Laboratory X. He is currently a full professor at University of Y. His areas of interest are: power electronics, electricity conversion quality, electronic control systems and electrical machine actuation.

Dr. Doe is member of the SOBRAEP, SBA and IEEE. Between 1998 and 2000, he was editor of the Brazilian Power Electronics Journal.