

## Accepted Manuscript

Chaotic analysis of embodied and situated agents

Federico Da Rold

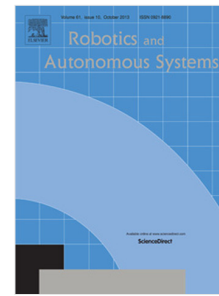
PII: S0921-8890(17)30233-6  
DOI: <http://dx.doi.org/10.1016/j.robot.2017.06.004>  
Reference: ROBOT 2862

To appear in: *Robotics and Autonomous Systems*

Received date: 8 April 2017  
Revised date: 14 May 2017  
Accepted date: 12 June 2017

Please cite this article as: F. Da Rold, Chaotic analysis of embodied and situated agents, *Robotics and Autonomous Systems* (2017), <http://dx.doi.org/10.1016/j.robot.2017.06.004>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.



# Chaotic Analysis of Embodied and Situated Agents

Federico Da Rold

*School of Computing, Electronics and Mathematics  
Plymouth University  
Plymouth PL4 8AA, UK*

---

## Abstract

Embodied and situated view of cognition is a transdisciplinary framework which stresses the importance of real time and dynamical interaction of an agent with the surrounding environment. This article presents a series of evolutionary robotics experiments that operationalize such concept, training miniature two-wheeled mobile robots to autonomously solve a temporal task. In order to provide a numerical description of the robots behavior, chaotic measures are estimated on the attractor reconstructed from the recorded positions of the agent. Chaos theory provides a rigorous mathematical framework consistent with an antireductionist approach, useful for understanding embodied and situated systems while avoiding a decomposition of the integrated system brain-body-environment. Time series are analyzed in detail using nonlinear mathematical tools in order to verify the presence of low-dimensional deterministic dynamical systems, a fundamental prerequisite for chaos theory. In particular, the recorded time series are evaluated with nonlinear prediction error to unveil deterministic dynamics, cross-prediction error to determine the stationarity of the signal, and surrogate data testing to verify the existence of nonlinear components in the underlying system. Estimators for quantifying level of chaos and fractal dimension are applied to suitable datasets. Results show that robots governed by a chaotic dynamic are more efficient at adapting to environments never experience during evolution, demonstrating robustness towards novel and

---

*Email address:* [federico.darold@plymouth.ac.uk](mailto:federico.darold@plymouth.ac.uk) (Federico Da Rold)

Download English Version:

<https://daneshyari.com/en/article/4948670>

Download Persian Version:

<https://daneshyari.com/article/4948670>

[Daneshyari.com](https://daneshyari.com)