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Artificial Intelligence (AI) — Assessment of the robustness of neural networks

Part 1: Overview

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National foreword

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Contents

Page

Foreword ..... **iv**
Introduction ..... **v**
1 Scope **1**
2 Normative references **1**
3 Terms and definitions **1**
4 Overview of the existing methods to assess the robustness of neural networks **3**
4.1 General 3
4.1.1 Robustness concept 3
4.1.2 Typical workflow to assess robustness 3
4.2 Classification of methods 6
5 Statistical methods **7**
5.1 General 7
5.2 Robustness metrics available using statistical methods 8
5.2.1 General 8
5.2.2 Examples of performance measures for interpolation 8
5.2.3 Examples of performance measures for classification 9
5.2.4 Other measures 13
5.3 Statistical methods to measure robustness of a neural network 14
5.3.1 General 14
5.3.2 Contrastive measures 14
6 Formal methods **14**
6.1 General 14
6.2 Robustness goal achievable using formal methods 15
6.2.1 General 15
6.2.2 Interpolation stability 15
6.2.3 Maximum stable space for perturbation resistance 15
6.3 Conduct the testing using formal methods 16
6.3.1 Using uncertainty analysis to prove interpolation stability 16
6.3.2 Using solver to prove a maximum stable space property 16
6.3.3 Using optimization techniques to prove a maximum stable space property 16
6.3.4 Using abstract interpretation to prove a maximum stable space property 17
7 Empirical methods **17**
7.1 General 17
7.2 Field trials 17
7.3 A posteriori testing 18
7.4 Benchmarking of neural networks 19
Annex A (informative) **Data perturbation** **20**
Annex B (informative) **Principle of abstract interpretation** **25**
Bibliography **26**

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Foreword

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Introduction

When designing an AI system, several properties are often considered desirable, such as robustness, resiliency, reliability, accuracy, safety, security, privacy. A definition of robustness is provided in 3.6. Robustness is a crucial property that poses new challenges in the context of AI systems. For example, in AI systems there are some risks specifically tied to the robustness of AI systems. Understanding these risks is essential for the adoption of AI in many contexts. This document aims at providing an overview of the approaches available to assess these risks, with a particular focus on neural networks, which are heavily used in industry, government and academia.

In many organizations, software validation is an essential part of putting software into production. The objective is to ensure various properties including safety and performance of the software used in all parts of the system. In some domains, the software validation and verification process is also an important part of system certification. For example, in the automotive or aeronautic fields, existing standards, such as ISO 26262 or Reference [2], require some specific actions to justify the design, the implementation and the testing of any piece of embedded software.

The techniques used in AI systems are also subject to validation. However, common techniques used in AI systems pose new challenges that require specific approaches in order to ensure adequate testing and validation.

AI technologies are designed to fulfil various tasks, including interpolation/regression, classification and other tasks.

While many methods exist for validating non-AI systems, they are not always directly applicable to AI systems, and neural networks in particular. Neural network systems represent a specific challenge as they are both hard to explain and sometimes have unexpected behaviour due to their non-linear nature. As a result, alternative approaches are needed.

Methods are categorized into three groups: statistical methods, formal methods and empirical methods. This document provides background on these methods to assess the robustness of neural networks.

It is noted that characterizing the robustness of neural networks is an open area of research, and there are limitations to both testing and validation approaches.

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Artificial Intelligence (AI) — Assessment of the robustness of neural networks —

Part 1: Overview

1 Scope

This document provides background about existing methods to assess the robustness of neural networks.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
artificial intelligence
AI
<system>capability of an engineered system to acquire, process and apply knowledge and skills

3.2
field trial
trial of a new system in actual situations for which it is intended (potentially with a restricted user group)

Note 1 to entry: Situation encompasses environment and process of usage.

3.3
input data
data for which a deployed machine learning model calculates a predicted output or inference

Note 1 to entry: Input data is also referred to by machine learning practitioners as out-of-sample data, new data and production data.

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