Consiglio Nazionale delle Ricerche

PUBBLICAZIONE, AI SENSI DELL'ART. 19 DEL d. lgs N. 33 DEL 14 MAARZO 2013, MODIFICATO DALL'ART. 18 DEL D. LGS N. 97 DEL 25 MAGGIO 2016 COME INTEGRATO DAL'ART. 1 C. 145 DELLA LEGGE 27 DICEMBRE 2019 N. 160, DEI QUESITI DELLA PROVA ORALE STABILITI DALLA COMMISSIONE ESAMINATRICE DELLA SLEZIONE DI SEGUITO INDICATA NELLA RIUNIONE IN DATA 19/09/2023

BANDO N. 400.02 INM PNRR

Selezione per titoli e colloquio ai sensi dell'art. 8 del "Disciplinare concernente le assunzioni di personale con contratto di lavoro a tempo determinato", per l'assunzione, ai sensi dell'art. 83 del CCNL del Comparto "Istruzione e Ricerca" 2016-2018, sottoscritto in data 19 aprile 2018, di una unità di personale con profilo professionale di Ricercatore livello III, presso l'Istituto di Ingegneria del Mare (INM) sede secondaria di Palermo, via Ugo La Malfa, 153 (CUP B43C22000440001)

Busta n.1 *(ESTRATTA)*

1. Il candidato discuta la realizzazione di un sistema di classificazione basato su reti neurali artificiali
2. Il candidato discuta il problema della generalizzazione e dell'overfitting per le applicazioni di machine learning.

Brano in inglese:

The current power systems are undergoing a rapid transition towards their more active, flexible, and intelligent counterpart smart grid, which brings about tremendous challenges in many domains, e.g., integration of various distributed renewable energy sources, cyberspace security, demand-side management, and decision-making of system planning and operation. The fulfillment of advanced functionalities in the smart grid firmly relies on the underlying information and communication infrastructure, and the efficient handling of a massive amount of data generated from various sources, e.g., smart meters, phasor measurement units, and various forms of sensors. In this paper, a comprehensive survey of over 200 recent publications is conducted to review the state-of-the-art practices and proposals of machine learning techniques and discuss the trend in a wide range of smart grid application domains.

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Busta N. 2

1. Il candidato illustri la differenza tra apprendimento supervisionato e non supervisionato
2. Il candidato discuta gli aspetti relativi all'implementazione di algoritmi di regressione

Machine learning (ML) models have been widely used in the modeling, design and prediction in energy systems. During the past two decades, there has been a dramatic increase in the advancement and application of various types of ML models for energy systems. This paper presents the state of the art of ML models used in energy systems along with a novel taxonomy of models and applications. Through a novel methodology, ML models are identified and further classified according to the ML modeling technique, energy type, and application area. Furthermore, a comprehensive review of the literature leads to an assessment and performance evaluation of the ML models and their applications, and a discussion of the major challenges and opportunities for prospective research. This paper further concludes that there is an outstanding rise in the accuracy, robustness, precision and generalization ability of the ML models in energy systems using hybrid ML models.

Busta N. 3

1. Il candidato descriva le principali fasi per la costruzione di un modello nell'ambito del machine learning
2. Il candidato presenti il concetto di apprendimento delle rappresentazioni attraverso il deep learning e ne discuta gli aspetti relativi all'implementazione

Trajectory predicting plays an important role in port and shipping management. The Automatic Identification System (AIS) is conducive to ship navigation safety for it enables the navigation information exchanges between vessels and shore authorities. However, the AIS data get lost occasionally for the communication reliability reasons. Hence, it is necessary to predict the trajectory of vessels to enhance shipping management. In this study, an approach for predicting trajectories of vessels by utilizing historical AIS data was proposed. Firstly, an interpolation method was employed to regularize the AIS data. Accordingly, a historical AIS database composed of thousands of trajectories are created. Secondly, a method for querying similar trajectories from the historical AIS database was designed. With the similar trajectories, the lost track points can be predicted by a regression model named Least Squares Support Vector Machine (LSSVM).

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Busta N. 4

1. Il candidato presenti il concetto di clustering, una panoramica dei relativi algoritmi e ne discuta gli aspetti relativi all'implementazione
2. Il candidato definisca cosa si intende per processo di normalizzazione dei dati in un approccio di machine learning e perché è utile

<u>Brano in inglese:</u>
Tratto da: R. Zhang, X. Zhang and X. Wang, "Gray-Box Modeling of Ship Manoeuvring Motion Using On-Line Support Vector Machine," 2022 4th International Conference on Applied Machine Learning (ICAML), Changsha, China, 2022, pp. 1-4, doi: 10.1109/ICAML57167.2022.00051

The ship maneuvering motion online gray box modeling is conducted with support vector machine (SVM) using sliding time windows. Taking the simulated data from 15°/15°zigzag test and the computed data for hydrodynamic forces and moment to be input and output respectively, the Online and offline SVMS are used to confirm the complex functions in the hydraulic power ship maneuvering movement model. The data from the 20°/20°zigzag simulation test and the identified nonlinear functions are applied to forecast the hydrodynamic forces and moment. The forecasted findings are compared with those of the hydrodynamic force and the moment calculation. The findings show that the recommended online SVM is superior to the offline SVM in determination of the complicated functions in the ship maneuvering motion hydrodynamic model and is a kind of useful gray-box modeling method for ship maneuvering movement.

Busta N. 5

1. Il candidato illustri le principali categorie di apprendimento nell'ambito del machine learning evidenziandone punti di forza e di debolezza ed eventuali ambiti applicativi
2. Il candidato discuta e presenti le principali tecniche per la limitazione dell'overfitting.

<u>Brano in inglese:</u>
Tratto da: D'Agostino, D., Serani, A., Stern, F. et al. Time-series forecasting for ships maneuvering in waves via recurrent-type neural networks. J. Ocean Eng. Mar. Energy 8, 479–487 (2022). https://doi.org/10.1007/s40722-022-00255-w.

The prediction capability of recurrent-type neural networks is investigated for real-time short-term prediction (nowcasting) of ship motions in high sea state. Specifically, the performance of recurrent neural networks, long short-term memory, and gated recurrent units models are assessed and compared using a data set coming from computational fluid dynamics simulations of a self-propelled destroyer-type vessel. Time-series of incident wave, ship motions, rudder angle, as well as immersion probes, are used as variables for a nowcasting problem. The objective is to obtain about 20 s ahead prediction. Overall, the three methods provide promising and comparable results.

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Busta N. 6 *(ESTRATTA)*

1. Il candidato presenti il concetto di classificazione e illustri le principali tecniche nell'ambito del machine learning
2. Il candidato illustri la differenza tra parametri iper-parametri di un modello predittivo basato su reti neurali artificiali

<u>Brano in inglese:</u>

Electrical energy generation represents an economical and environmental challenge requiring an optimal control of the production process. An accurate modeling of the electrical energy is essential to develop efficient forecasting systems. To achieve this goal, this paper introduces an innovative load forecasting approach using Load Profiles (LPs). First, the power consumption in Algeria is analyzed to detect the different factors affecting the demand. Then, the fluctuation of the seasonal data is applied through hourly temperature profiles. The LP-based forecasting is performed using three levels (annual, weekly and daily) LP-propagation. Short-term and mid-term load forecasting models were developed using multiple Artificial Intelligence techniques. Among them, a two-dimensional Convolutional Neural Network (CNN) used here for the first time in load forecasting.

Busta N. 7

1. Il candidato illustri le principali tecniche di riduzione della dimensionalità dei dati, discutendone vantaggi e svantaggi
2. Il candidato descriva le principali metriche di valutazione di un algoritmo di machine learning

<u>Brano in inglese:</u>

Cyber-physical systems (CPS), such as smart grids, include cyber assets for monitoring, control, and communication in order to maintain safe and efficient operation of a physical process. We propose that CPS intrusion detection systems (CPS IDS) should seek not just to detect attacks in the host audit logs and network traffic (cyber plane), but should consider how attacks are reflected in measurements from diverse devices at multiple locations (physical plane). In electric grids, voltage and current laws induce physical constraints that can be leveraged in distributed agreement algorithms to detect anomalous conditions. This can be done by explicitly coding the physical constraints into a hybrid CPS IDS, making the detector specific to a particular CPS. We present an alternative approach, along with preliminary results, using machine learning to characterize normal, fault, and attack states in a smart distribution substation CPS, using this as a component of a CPS IDS

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