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Deep Learning for real applications

Vishal Nandigana
nandiga@iitm.ac.in
IITM, Chennai, Tamil Nadu

ABSTRACT

In this paper, we provide a new artificial intelligence based deep learning formulation Distributed Artificial Neural Network (DANN) for real applications, AC placement in a room, design of new car doors from existing 15 given car doors, with six orders of magnitute speed up in computational time and need an everyday use laptop, not necessitating high end super computer servers for real application design and analysis. Further, the accuracy of the real application solution showed 99.9% accuracy and comparable to the conventional existing engineering applications software results.

Keywords— *Artificial Intelligence, Deep Learning, DANN, Product Design, Generative Design, AIDesign*

1. INTRODUCTION

Physical quantities such as temperature, stress, is typically predicted on 3D body to design and manufacture the final 3D product like Air Conditions (AC) in a typical 100 sq. Ft room in a house. And real design products like car door of a typical 1.5m car door of different SUVs, minivans, sedans and hatchback cars with window panel(s) for real product design and manufacturing applications [1]. Partial differential equation (PDE) mathematics and CAD/CAE software design and analyse the basic underlying physical laws and rules and design data book rules which help us calculate temperature profiles and CAD/CAE design and manufacturing ready product designs to help industries [1–6].

Over the last four hundred years PDEs are solved by analytical methods like separation of variables, Fourier series, finding an intergral form of the solution, change of variable method to transform the equation to something that is easily solvable. FEM/FDM/CFD methods along with CAD/CAE software packages are used for solving a real world industry product design and analysis for market ready and accepted design and analysis 3D body products for market use. However, FEM/FDM/CFD along with CAD/CAE takes long computational time and high performance super computing facilities and servers and building space oftentimes few months, with 100 Teraprocessors running for billions of node and server months, with space used of 6-8 acres of land use. The challenges are continued to be addressed across the globe with google making recent headlines on solving a complex pattern recognition task with revolutionary quantum computing hardware which otherwise would take 10,000 years for a summit supercomputer - the most powerful in the world today - to solve.

Deep Learning was initially introduced as an automatic feature extraction system, requiring minimum pre-processing effort by the user [7, 8]. This is an old technique that has existed from 1940 and is known by different names such as - Cybernetics and Connectionism [7]. It was reintroduced as deep learning in 2007 [8]. The sudden increase in popularity of this field was due to the development of niche algorithms for training these networks. The most popular deep learning models are Convolutional neural network (CNN) and its next developed algorithms such as Recurrent Neural Network (RNN) and Reinforcement Learning (RL) [8], which uses images to identify similarities and patterns.

2. MATHEMATICAL FORMULATION OF DEEP LEARNING FOR REAL APPLICATIONS

2.1 Distributed Artificial neural network (DANN)

The input data at each point i and for each sample, j, is trained using Distributed Artificial neural network (DANN), where the activation function is RELU function. The mathematical formulation of DANN is given below.

$$DANN = \forall \oint_{\Omega} \int_{j=1}^{M} (h_{j_i} + b_{2_i}) djd\Omega_i \tag{1}$$

$$h_{j_i} = W_{1_i} \cdot h_{j-1_i} + W_{2_i} \cdot x_{j-1_i} + b_{1_i} \tag{2}$$

input, h_{ji} is the hidden cell state and W_{1i}, b_{1i} and W_{2i}, are the weight and bias matrices for hidden-hidden and input-hidden connections, Ω is the domain of interest, m is the number of training examples the boundary condition for each grid point i, for sample j, is denoted as b_{2i}.

2.2 DANN algorithm

Here, for a given real application, design and analysis, boundary conditions, along with existing car doo r+ window panels designed according to design data book rules of car market industries using CAD/CAE designs are used as training sets to extrapolate the new car product door + window intuitively and intelligently for new car door + window panels for the same car product, like SUVs, minivans, sedans and hatchbacks. The extrapolated design and analysis for new 3D product designs are design data book compatible and agreeable and approved by car manufacturing industries, and patent approved and the software is commercially made available for industries under the foundation industry AIDesign PVT LTD, legally approved and patent approved and available over https://aidesign.today. A set of 15 training data sets stored in .csv files are used for the DANN training algorithms and a set of 100s extrapolated new 3D product designs, design data book rules approved and patent approved and industries approved new extrapolated 3D product designs are made available in .csv files using DANN and AIDesign software.

3. RESULTS

3.1 Placement of an AC in a 100 sq. Ft room in a house (3D)

Fig. 1 shows the training AC placement (not intelligently placed in a room) before DANN use and an intelligent AC placement with best heat transfer and cooling to the room and menfolk at all times in a day after using the DANN use and AIDesign software. The software is patented and industries approved and commercially available over https://aidesign.today for product design and analysis real world product industrial use.

3.2 Selection of a new car door + window for SUVs, minivans, sedans and hatchbacks

Fig. 2 shows 15 already existing 3D car industries car door + window for different SUVs, minivans, sedans and hatchbacks before DANN use and an intelligent extrapolated design data book rules followed and generated DANN result a new car door + window using AIDesign software. The software is patented and industries approved and commercially available over https://aidesign.today for product design and analysis real world product industrial use.

4. CONCLUSION

In this paper, we provide a new artificial intelligence based deep learning software AIDesign software uses Distributed Artificial Neural Network (DANN) formulation for real applications, AC placement in a room, design of new car door + window for SUVs, minivans, sedans and hatchbacks with six orders of magnitute speed up in computational time and need an everyday use laptop, not necessiating high end super computer servers for real product design and industry manufacturing use. Further, the accuracy of the real application solution showed 99.9% accuracy.

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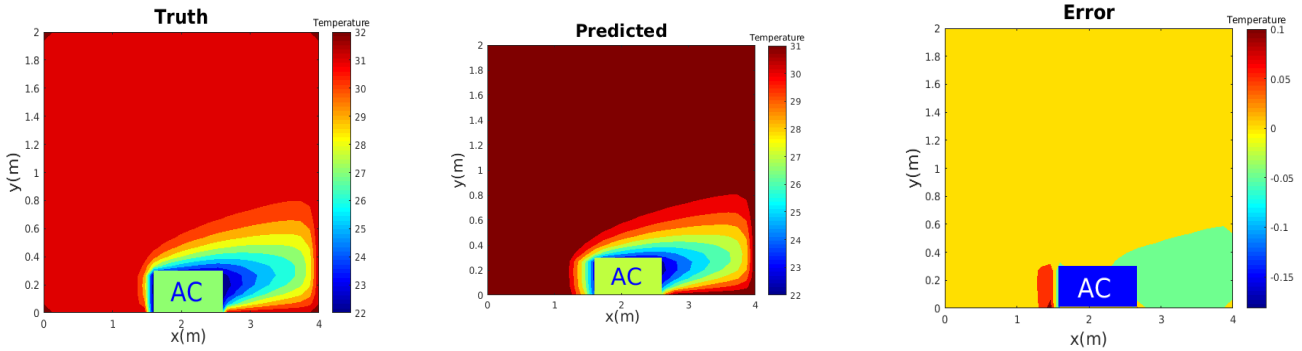
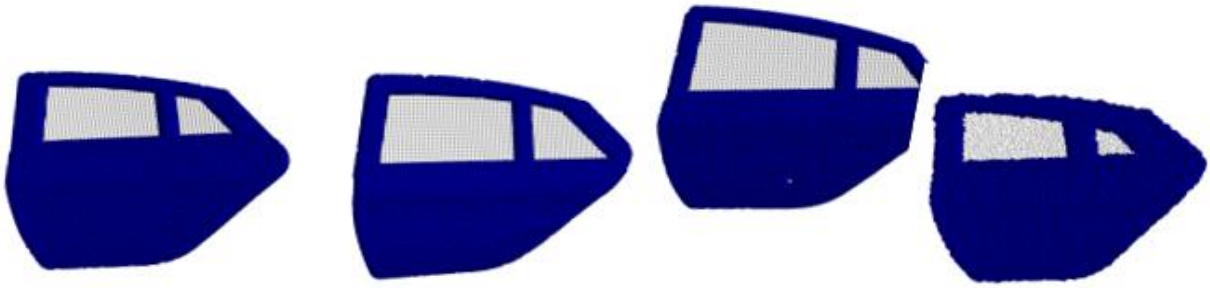


Program: Commercial software
Computer time: 20 seconds

Program: AIDesign software
Computer time: 0.01 seconds

AC set temperature: 20 C
Room initial temperature: 32 C

Fig. 1: Comparison of commercial software vs AIDesign, DANN intelligent result. AIDesign software can be accessed and downloaded and use under fee payments from https://aidesign.today



Design 1 -Solidworks **Design 2 -Solidworks** **Design 3-Solidworks** **Design: Prediction (AID)**

Fig. 2: Generative design of 3 car door + window of SUVs, minivans, sedans and hatchbacks using commercial conventional CAD/CAE software, Solidworks and new extrapolated intelligently predicted new 3D car door + window product using DANN use and AIDesign (AID) software. The software can be accessed and downloaded and use under fee payments from https://aidesign.today

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