

## International Journal of Innovative Research in Science, Engineering and Technology

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# Role of Artificial Intelligence in Mechanical Design Systems

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**ABSTRACT:** Artificial Intelligence is a type of Intelligence developed by machines, robots or software in order to take decisions on its own .Artificial intelligence requires the knowledge of Probability, Statistics, neural networks, computer science, programming, mathematical optimizations. Artificial intelligence is one of the most vital part of the technological era that has helped to solve challenges involving computer science ,mathematics ,linguistics ,psychology, neuroscience in the field of healthcare, automotive ,finance etc. It basically has a wide range of application such as Recognition of Pattern and Image, game playing, making Decisions, sequence recognition. In this we are going to study the specific application of the ANN in the designing of different Joints which turn out to be very easy and efficient method

**KEYWORDS:** Artificial Intelligence, Joints, Knuckle, RNN, Activation Function, Case Studies

### I. INTRODUCTION

Artificial Intelligence is a type of Intelligence developed by machines, robots or software in order to take decisions on its own .Artificial intelligence has many goals such as reasoning, natural language processing, planning, Knowledge, learning, speech recognition, handwriting recognition etc.Basically it has the goals such as to create expert level human intelligence in machines. Artificial intelligence requires the knowledge of Probability, Statistics, neural networks, computer science, programming, mathematical optimizations. Artificial intelligence is one of the most vital part of the technological era that has helped to solve challenges involving computer science ,mathematics ,linguistics ,psychology, neuroscience in the field of healthcare, automotive ,finance etc.

### II. ARTIFICIAL NEURAL NETWORK (ANN)

Human brain contains 10 billions of neurons which are highly interconnected. Simple neurons can execute a single on its own but to execute a complex all the neurons needs to function together. Neurons have characteristics such as massive parallelism, connectivism as they are highly interconnected and distributive associative memory that is they can model their weights in the synaptic connections.

ANN takes two fundamental units from biological neuron units

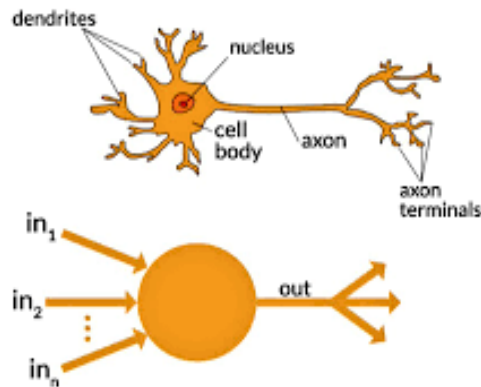
- 1.Nodes→Neuron
- 2.Weights→Synapses

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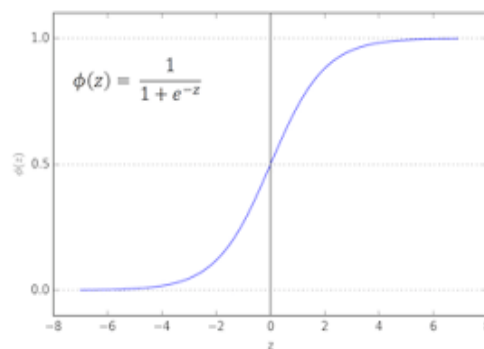


Neural Networks are basically the backbone of the Artificial Intelligence .It basically finds out a new function which can be formed by the help of interconnected neurons .The weight and bias of the neurons are changed during the training of the network with the help of the errors by following the backpropagation method .The activation function when applied to the linear combination of activated neurons gives an output

### III. TYPES OF ACTIVATION FUNCTIONS

#### 1. Sigmoidal Function-

- It is written as  $F(x) = 1 / (1 + e^{-x})$
- It generates smoother range of output values between 0 and 1. Smooth curves allow us to do prefer it over the step functions.
- Values
  1. If  $x$  tends to  $\infty$
  2. Then  $-f(x)$  becomes 1
  3. If  $x$  tends to  $-\infty$
  4. Then  $f(x)$  becomes 0



#### 2. ReLU Function-

- It stands for Rectified linear units  $f(x) = \max(x, 0)$
- Values
  1.  $x > 0 \rightarrow x$

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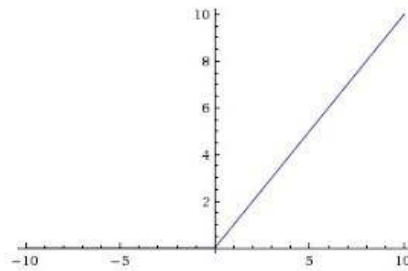
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2.  $x < 0 \rightarrow 0$

- It gives a constant value of the derivative for all the values which are greater than 0 which helps to train the inputs faster
- 



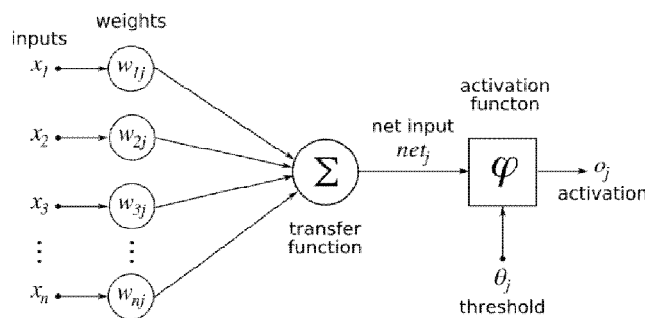
### 3. Softmax Function-

These functions are normally used for the problems which involve classification. This one is almost equal to the sigmoid function except that output values are normalized to the sum of 1. It is suitable for the binary output but it would be easier to denote values for each class which can be later illuminated as possibilities

## IV. TYPES OF NEURAL NETWORKS

### Recurrent Neural Network

It is used where the data is used in a sequential manner such as a particular output is generated with the help of the previous output approximately  $t$  times. The final output is sent to the next layer after all the epochs has been done which is in the most generalized form. It is a type of AI where connections between units lead a directed cycle; RNNs use its internal memory to execute random sequences of inputs. RNNs are typically used for the application such as speech recognition.



### Multilayer Feed forward Neural Network

It belongs to the class of artificial neural network which are feed forward in nature. It should contain at least three layers of neurons. Other than input nodes, each node belongs to a neuron that makes a uses a function. (Nonlinear activation) For training it uses backpropagation method which is a supervised learning technique it is capable of separating the data which is not linearly separable.

### Covalent Neural Network

These are applied to image data. For example we have an input image of  $(28 \times 28 \times 3)$  dimension. If we do the analysis by normal neural network it will take 2352 parameters for analysis. And as the image keeps getting bigger the number of parameters quantity also rises. We “convolve” the images to basically lower parameters quantity. On applying the filter over the size dimensions of the input, it will give a **2-dimensional activation map** which is the output of that filter at

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every position. We have to make a stack of these maps along the depth dimension which will help us to produce the output volume.

## V. APPLICATIONS OF ANN

It basically has a wide range of application such as

- Recognition of Pattern and Image
- Game playing
- Making Decisions
- Sequence recognition
- E-mail spam filtering
- Social Network filtering
- Medical Diagnosis
- Quality Control
- Physical System Modelling
- Signal Processing
- Electrical Load Forecasting
- Energy Demand Forecasting
- Power Control System
- Boolean function

## VI. WHY ANN

Scientists and researchers are also making the intelligent machines which are just as intelligent as a human being, and ANN plays a very important role in the achieving the same goal such as Neural Networks helps in finding the sure shot solution of those problems for which basic mathematical method is complicated. Neural networks actually learn by example, so there is no need for program it at much extent. Neural networks have a higher degree of accuracy and speed. It can helps in the interaction between the inputs provided to it. It provides a huge of advantage of representation of any continuous function and the Boolean function

## VII. CASE STUDIES INVOLVING ANN AND MACHINE DESIGN

### Cotter and Sleeve Joints Design

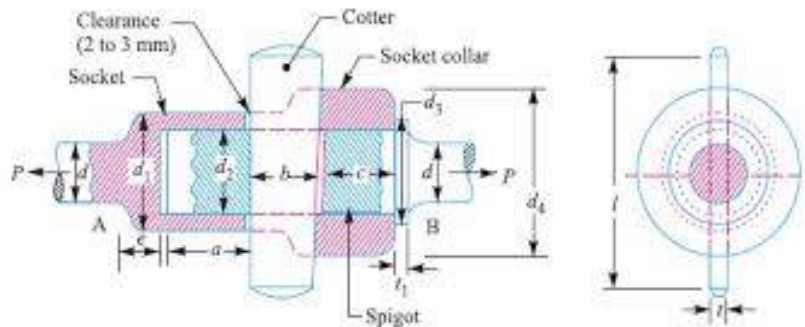
Sleeve and Cotter Joints design is one of the pivotal aspects of the Mechanical Engineering Design. It is applicable in situations where we have to connect two rods. A sleeve or muff surrounds the rods and then cotters are fitted into the holes already present in the sleeve and rods. In this case we will discuss the use of the neural networks in the design of the Cotter Joints. In this case we will consider the failure of rods or cotter under the crushing stress. Well there is an alternative method to the analytical method that is the finite element analysis The FE approach calls for simulations of the same problem of failure of cotter rods with varied diameter of the sleeve and the thickness of the cotter, making it a time consuming affair.

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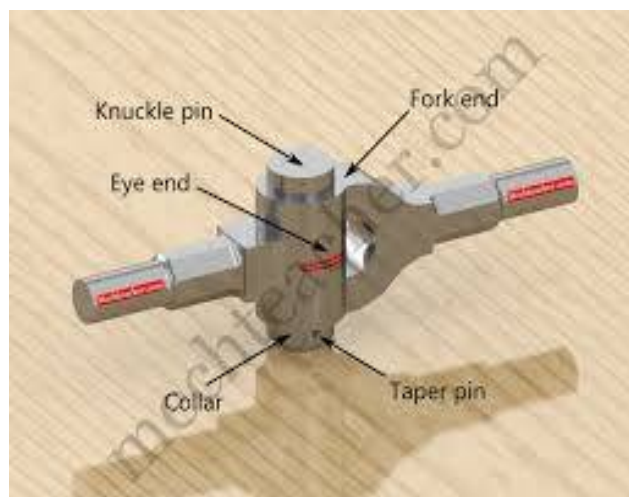
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We have tried to reduce the time and increase the efficiency using ANN. The Cotter joint beam is analysed to resist some tensile load with all parts of the joint being made up of the isotropic material with the allowable stresses such as permissible tensile stress, shear stress and crushing stresses. Of the Design parameters  $d_2$  and  $t$ . Here,  $d_2$  -sleeve diameter  $t$ - the cotter thickness (mm).Input and results can be used as training data for our ANN. Some of the values are not included in the training because it is to be used as test data. This network uses feed forward Method and uses Back-Propagation Algorithm for training the network.

## Design of the Knuckle Joint

Design of the Knuckle Joints is one of the most pivotal aspects of the Mechanical Engineering Design. It is applicable for round rods which are under the tensile loads. It can be readily disconnected for adjustments and repair. In this type, one end of the rods is made into an eye and the other end is made into the form of a fork with one eye in each of its fork leg. The pin passes through both the eye and fork holes and can be secured by the help of the collar pins. In this case we will discuss the use of the neural networks in the design of the Knuckle Joints. In this case we will consider the failure of a rod end under the crushing stress. Well there is an alternative method of the analytical method that is the finite element analysis The FE approach calls for simulations of the same problem of failure of cotter rods with varied diameter of the pin and the thickness of the single eye, making it a very cumbersome task. We have tried to reduce the time and increase the efficiency using ANN.



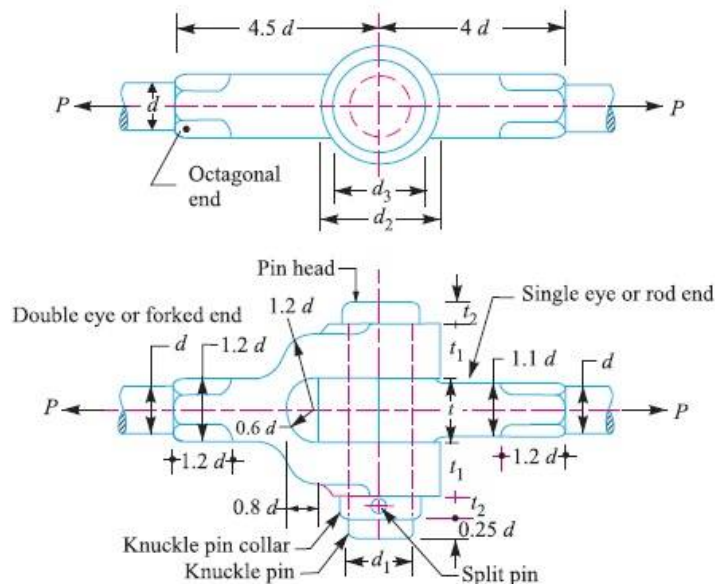
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### Socket and Spigot Cotter Joint Design

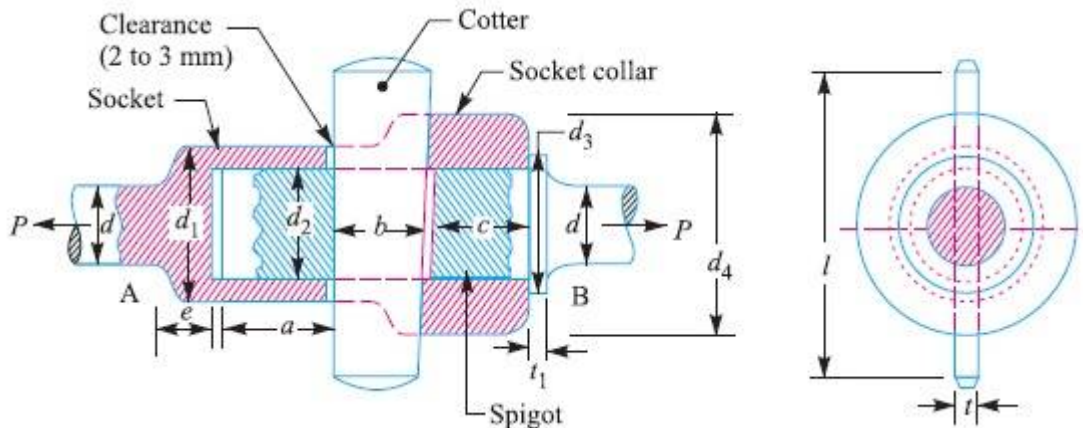
Design of the socket and spigot Joints is one of most pivotal aspects of the Mechanical Engineering Design. In this load is axial in nature but it can change its direction so it can be both the tensile and compressive in nature. In this type, one rod end is socket type and other goes into the socket called the spigot. Socket and spigot generally has a hole inside them which is rectangular in shape A cotter is fitted into the hole with the purpose of making temporary connections between them this case we will discuss the use of the neural networks in the design of the Knuckle Joints. In this case we will consider the failure of the rod end under crushing stress. Well there is an alternative method of the analytical method that is the finite element analysis The FE approach calls for simulations of the same problem of crushing failure of cotter rods with varied diameter of the spigot and the thickness of the cotter, making it a very cumbersome task. We have tried to reduce the time and increase the efficiency using ANN. The spigot cotter joint beam is analysed to resist some tensile load with all parts of the joint being made up of the isotropic material with the allowable stresses such as permissible tensile stress, shear stress and crushing stresses.

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## VIII. CONCLUSION

One of the most important conclusion regarding these case studies is that we can also take the help of the Artificial intelligence which is on the boom now a daze .This way we can achieve our results in a more simple and efficient manner .

## REFERENCES

1. <https://www.analyticsvidhya.com/blog/2017/05/neural-network-from-scratch-in-python-and-r/>
2. <https://www.analyticsvidhya.com/blog/2017/09/creating-visualizing-neural-network-in-r/>
3. [https://en.wikipedia.org/wiki/Artificial\\_intelligence](https://en.wikipedia.org/wiki/Artificial_intelligence)
4. [https://en.wikipedia.org/wiki/Artificial\\_neural\\_network](https://en.wikipedia.org/wiki/Artificial_neural_network)
5. A Textbook of Machine Design RS Khurmi-Cotter and Knuckle Joints