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Combination Between MRF And Muscle Wire

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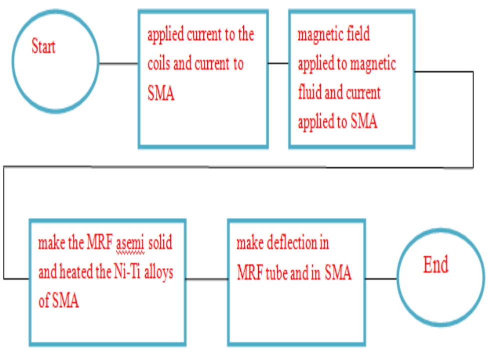
Abstract - This paper describe the combination between magneto rheological fluid (MRF) and muscle wire .MRF named smart fluid, is used as a blood robot to control finger robot mechanism instead of using a motor, pneumatic and hydraulic systems . In this study, the MR and muscle wire, controls the finger robot motion. It can be exploited for another usage, for example; it can reduce noise and vibration. compared with the mechanisms that use a motor, pneumatic and hydraulic systems

1. INTRODUCTION

To show the reader what previous researches have been done in these fields, a previous methodology, and evaluates prior studies to show a lot of information gap which this research will try to cover. The reviewed literature are grouped and presented in two sections. First for a magnetic rheological fluid and the second deals with a muscle wire. There is a new technology to improve the design of robotic hand Amirul Bin Sait 2008 [1]; Magnetic fluid was used to develop a potential application in gripping mechanism. The properties and the influences of this fluid in positioning are gathered and the researches started with identifying the title main element which is magnetic fluid and the robot gripping mechanism. The mechanisms are developed, so the development of the robot gripping mechanism is presented to come out with a replica. The methodology consists of the method used on an explanation related to the robot gripping mechanism development. The simulation output shows how the mechanism works and gives better understanding about the magnetic fluid movement. Analysis of the force and the moment for the finger and shaft is presented according to FOD from the replication. The spring constant or force constant of the spring is determined to know the suitable spring force. In addition the viscosity of the MR fluid is discussed as it reflects proportionally to the current. G.Bossis, et al 2002 [2], The magnetic flux lines move from north pole to the south pole. To develop the robot gripper, it requires movement and Force .Magnetic fluid is used as an active medium for generating a variable magnetic force, which will act, and enables the movement. The magnetic force will be produced from the movement of the magnetic fluid that can be controlled by the current through the coil installed. A permanent magnet can also produce a magnetic field; however, the coil is better for the concentration of the magnetic field and can be manipulating. As a result, it will transmit the force to the actor of the robot gripper. Shinji Matsubara ,et al 2012 [3**],** The purpose was to develop a prosthetic hand using shape memory alloy (SMA) type artificial muscle and presents the following experiments in the development of the prosthetic hand by experiments determining the properties of the SMA. Finally, an experiment investigating the usefulness of the prosthetic hand is presented. It will also improve accuracy and reduce the heat generated, allowing the hand to have real-life applications. S.Dilibal , et al 2001[4**],** Gripping of different types of objects with a multi-finger robot hand is a vital task for robot arms. Grippers, which are ending effecter elements in robot applications, are employed in various industrial operations such as transferring, assembling, welding and painting. A general-purpose robot hand is going to be required. There are various technological actuators of robot hands such as electrical, hydraulic and pneumatic motors, etc. Besides these conventional actuators, it is possible to include Shape Memory Alloys (SMA) in the category of technological actuators. The MR fluid will be an active medium to replace the conventional mechanism. However, more compliant system was sufficient for precise motion control during the intermittent degree .



Fig(1) Flowchart for control finger robot through blood robot

The primary electro-magnetic circuit equation is listed below which serves as the starting point for the development of the second design equation. It states that the number of turns of the electrical conductor multiplied by the value of the current, which travels along the conductor is equal to the magnetic flux traveling through the MR fluid multiplied by the total reluctance of the magnetic circuit:

$N . I = \o . S$
N=number of turns
I=electrical current
Ø=magnetic flux
S = Reluctance

Reluctance $= \sum_{i=1}^{n} si$ …(1)…[5]

In equation (1) reluctance is simply equal to the sum of all the individual reluctances within the magnetic circuit.

$Si = \frac{Li}{\mu i \; Ai}$ ..(2)…[5]

Li =length of flux path

µi = permeability

Ai = cross-sectional area perpendicular to flux

The magnetic flux crossing the MR fluid is also equal to the magnetic flux density B, multiplied by the cross-sectional area of the MR fluid tube, AMR, that is perpendicular to the flux path:

Ø =BAMR ..(3)…[5]

NI = BAMR $\sum_{i=1}^{n} si$..(4)...[5]

By using known properties of the particular MR fluid, The flux density, B, can be determined as follows, by locating the maximum yield stress on the 'Yield stress vs. magnetic-field strength' yield stress can be looked at the plot for the specific MR fluid properties. Next, look at the x-axis to determine the corresponding magnetic-field strength value, H. Using the magnetic-field strength determines the corresponding flux density value, and by using the magnetization curve of the material . Thus, the only remaining unknowns in equation above are the number of turns, N, and the electric current, depending on the available space for windings from the geometry of the MR device, the current carrying capacity of the wire, and maximum voltage capabilities of the power source. So, N was selected by using the above equations.

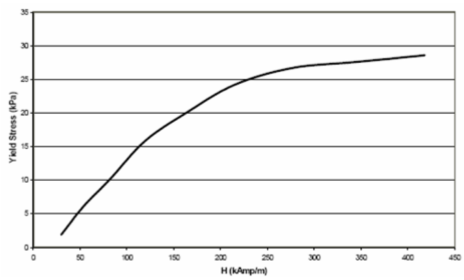


Fig.(2) Yield stress vs .magnetic field strength[5]

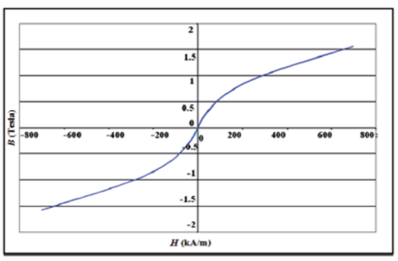


Fig.(3) The magnetization curve of the MR (B-H) relationship

3-1 HARDWARE DESCRIPTION

Preparation of Magnetic-Fluid

The magnetic rheological fluid contains a mixture of pure iron (Fe) with percentage of purity (98%) . The grain size about is (1- 10)µm. The carrier oil could have different viscosities like (hydraulic oil, silicon oil, carbonic oil...etc.), but many experiments of preparation showed that the mixture of only this component is suffering from a high percentage of deposition in the iron atoms so a little mixture of lithium grease has to be added.

Effect of Time on the Magnetic Rheological Fluid

effect on time to the magnetic rheological fluid is to be carried out to show this effect : 1-In the first second , After 3 minutes , After 15 minutes and After one hour. The structure of particles in MR fluid gradually changes when a magnetic field is applied. So studying it

Electromagnet ring core

Electromagnet ring core has more advantages than an electromagnetic nail core in this project with respect to the phalangeal of fingers. All what is required to do is to wrap some copper wire around an iron core. If an electric current began to flow, the iron core would become magnetized. When the coil is disconnected from the supply, the iron core will lose its magnetism. So all materials needed are: 1- Iron ring of three centimeters in diameter(core), 2-One meter of stranded copper wire, guage AWG 16 ., 3-One A-cell voltage source connected to coil with transformation The copper wire is manually wrapped around the iron core to activate electromagnetic ring with AC voltage source

The effecter of EMF are:

Electric current applied to coil make magnetic flux density change(I).. Radius of coil makes magnetic flux density change(R).. Radius of ring core makes magnetic flux density change(r).

Hard ware design

Figure () demonstrates a general view of this proposal work. There are two main steps in the complement design and implement phase. The first step is the design of a finger robot without motor phenomena. The second step is to make synchronism between activation of MRF tube and muscle wire.

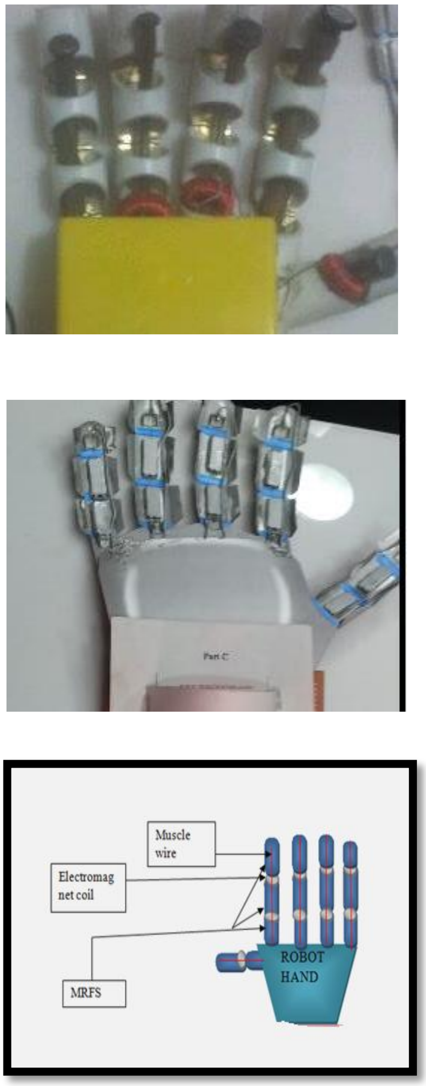


Fig.(4) Simulation and Actual work of design hand robot

To design finger robot by using blood robot and muscle wire, certain difficulties in this project should be overcome which are: The design of this finger is made only by this component.and Make synchronize movement between phalangeal which contains electromagnet ring and magntic rheological fluid and muscle wire.and Install magnetic rheological fluid tube in temporary base phases to avoid deposition outwardly. The perfect design called tip to base design contains one plastic tube of magnetic rheological fluid mounted on the total length of finger. By applying electro-magnetic coil in the tip of finger and the other in the base of finger so named (Tip to Base design) this design is similar to technique of studying MRFs. when applying electrical signal to the lower coil (in the base of finger) .The rheological fluid is converging solid iron grains to the lower coil causing force which activates PP joint to make a small motion which is shared by using a muscle wire make to increases activation of finger and makes motion faster , an advantage of this design is to make easy synchronism between electro-magnet coil activity and muscle wire activity. But However, disadvantage of this design is the lack of control of the MP joint finger because there is one plastic tube containing magnetic rheological fluid along the long finger.

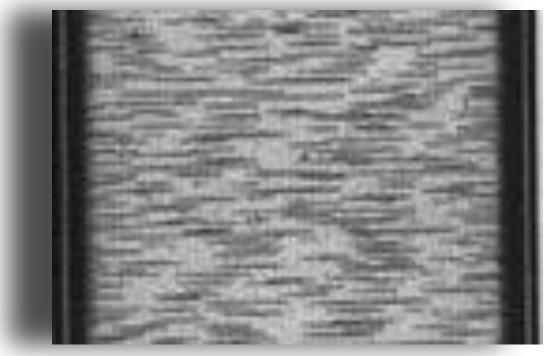
Fig.(5) Tip to base prototype design

.. 5-1 RESULTS

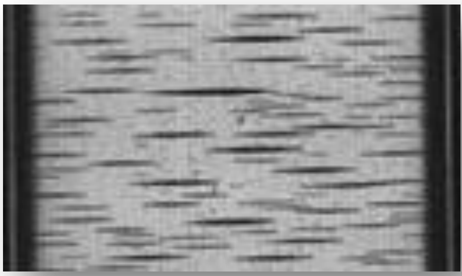
Effect of Time on the Magnetic rheological Fluid

The structure of magnetic particles in MR fluid gradually changes when magnetic field is applied. Time has a considerable effect on its fibrous network . All these result were taken by slides under a microscope. 1-Figure(5.8) shows MR fluid after 1 second of exposure to a fast-changing magnetic field. The suspended particles form a strong, fibrous network.

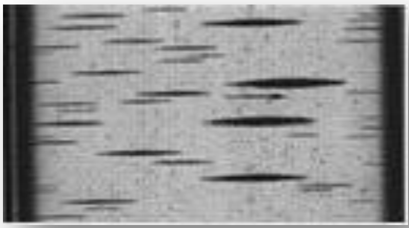
Fig(6) MR under microscope after 1-sec



Fig(7) MR under microscope after 3-minutes



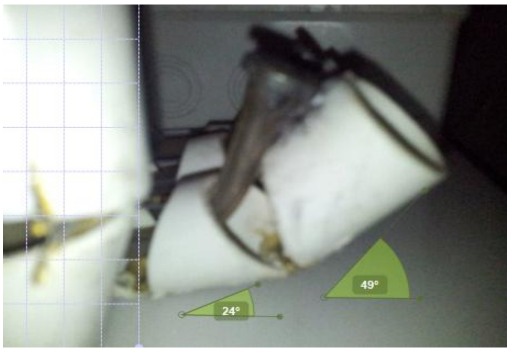
fig(8) MR under microscope after 15minutes

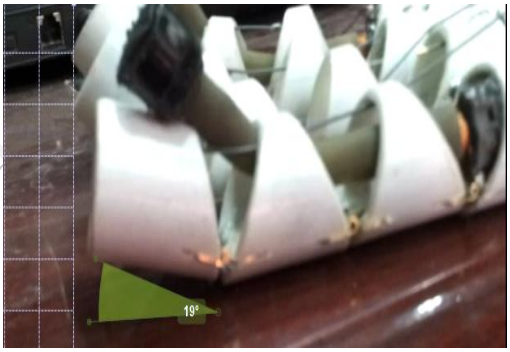


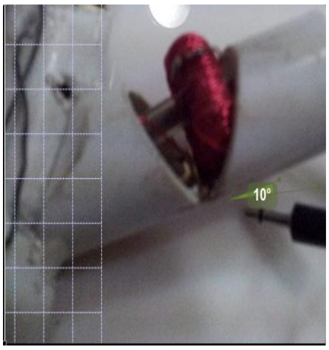
Fig(9) MR Under Microscope After 1-Hour

Control of Finger robot Through Bloody Muscle

It is well known that the activation of MRFs tube is slow activation of tube occurs after is take (13.36 sec). So to increase the reaction and decrease the time with a high percentage a muscle wire must be used. And When the voltage is increased above the limited voltage which is applied to the muscle wire it may face damage of the material of the Ni-Ti. So one should be careful while treating with muscle wire. and Muscle wire bears only a small weight so in the present work light weight is used only to simulate a movement. if required to increase the lifting weight, a catalyst (similar to spring) should be used.







Fig(10) Fingers angle with angles of joints drived by bloody muscle

1- 6-1 CONCLUSION

The optimal parameters of magnetic rheological fluid which were concluded from this study are : grain size=8.23 micrometer, viscosity=172 mpa.s, diameter of tube=0.7 cm and voltage applied =14.7V

2- By designing the finger of robotic hand through combination between magnetic rheological fluid and muscle wire to make activation of the finger robot .The angle which was obtained is small; so for index finger (19º DCP&0º MCP); middle finger (32º DCP &11º

MCP &0º PCP); ring finger (49º DCP & 24º MCP & 0º PCP); pinky finger (23º DCP&0º MCP); thumb finger (10ºDCP &0ºMCP(fixed)).

3- By muscle wire deriver To activate movement of finger robot, the degree which was obtained is small degree so for index finger (37º DCP&20º MCP); middle finger (70º DCP &28º MCP &15º PCP); ring finger (77º DCP & 54º MCP & 28º PCP); pinky finger (46º DCP&26º MCP);thumb finger (44ºDCP &17ºMCP).

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