PATENT

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Title of the invention: Hardware Realization FPI Fractional Controller

Technical field of the invention: Electrical Engineering

Prior Art:

The Fractional PI (FPI) controller applied to a DC motor system, The FPI controller is designed to achieve the desired control performance by adjusting the values of Kp, and Ki. The FPI controller's transfer function is then combined with the motor's transfer function (G(s)) to form the closed-loop transfer function for the DC motor system. These are widely used in control systems, and there may be prior art on hardware implementations and visualization techniques for PID controllers, which could provide a foundation for fractional controllers. FPI-PD controller is proposed for the speed control of BLDC motor where a fuzzy PI controller is in the forward path and a conventional PD controller is in an inner feedback loop. The gain parameters of the proposed controller are calculated by the gradient descent optimization method. The mathematical model of the DC motor is derived for 864 evaluating the performance of the proposed controller. MATLAB/Simulink environment is used for the simulation. The obtained results are then compared with the conventional PID controller and the existing fuzzy PID controller. The results show that the proposed controller performs better than both of the controllers mentioned above in terms of rise time, percentage overshoot, and settling time.

Objective of Invention:

Efficiency:

Genetic algorithms explore a wide range of parameter combinations simultaneously, quickly narrowing down to optimal values.

Automation:

Manual tuning involves guesswork and experimentation. Genetic algorithms automate the tuning process, saving time and effort.

Adaptability:

PID parameters can change with environmental conditions or system dynamics. Genetic algorithms can adapt and retune the PID controller as needed.

Improved Performance:

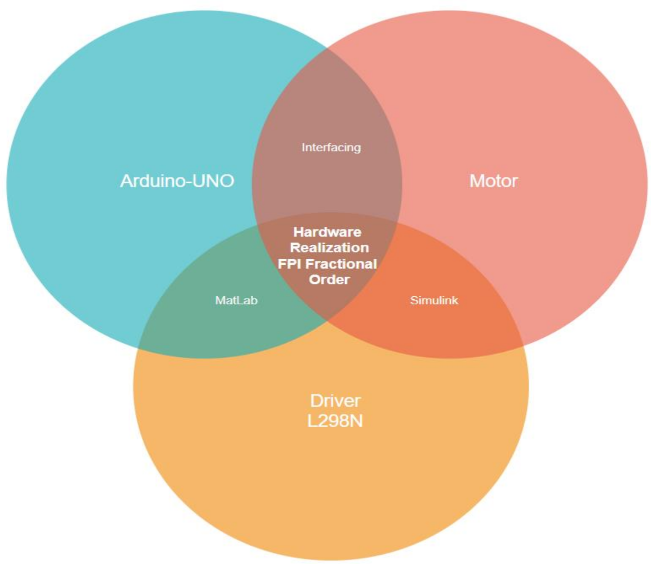
Genetic algorithms often discover parameter sets that outperform manually tuned ones, leading to better control system performance.

Synopsis:

The proposed system includes a hardware component and a software component. The hardware component includes an Arduino Uno microcontroller, an L298N motor driver, an IR sensor, and a DC motor with encoder. The software component is implemented in MATLAB Simulink and includes a dashboard for visualizing and controlling the system in real-time.

The system works by first measuring the speed of the DC motor using the IR sensor. The measured speed is then sent to the FOPID controller, which calculates the appropriate control signal. The control signal is then sent to the L298N motor driver, which drives the DC motor at the desired speed.

Brief Description of Block Diagram:



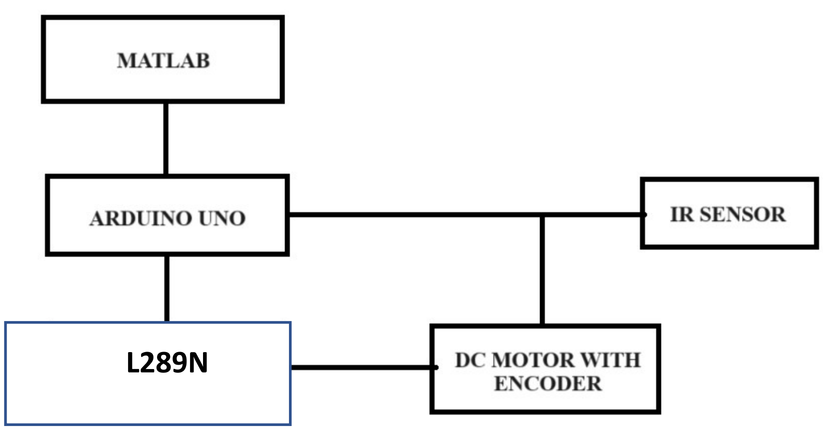


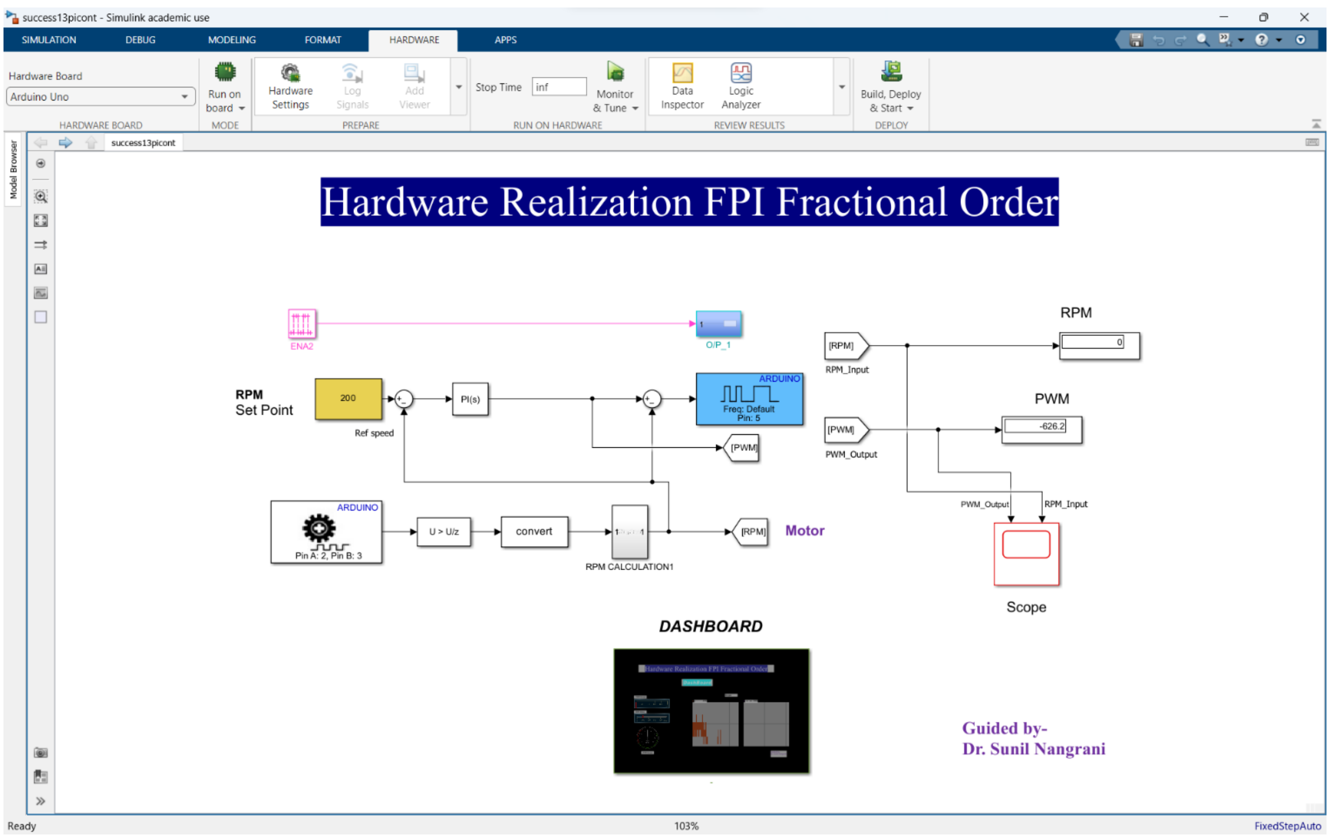
Fig: BLOCK DIAGRAM

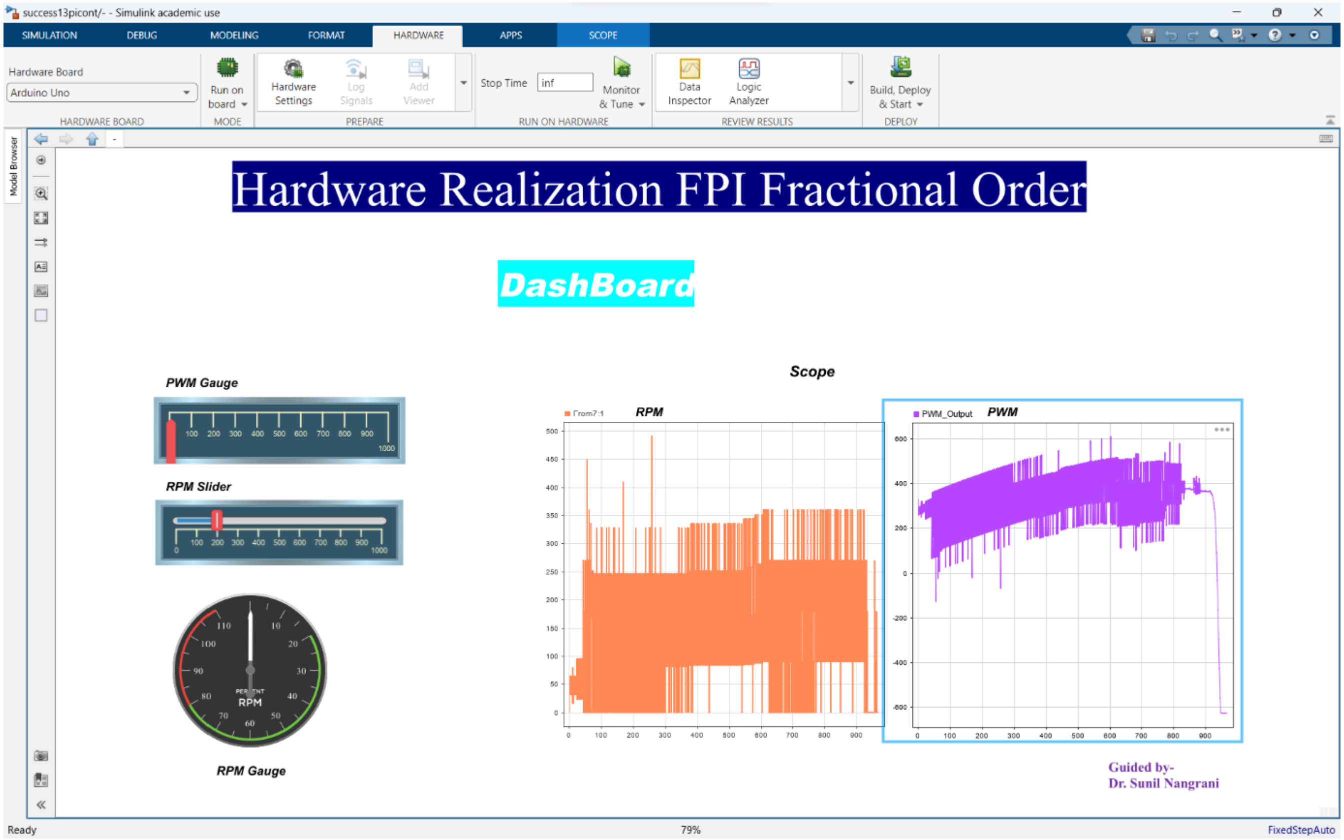
When we start the Simulink from MATLAB it will gives signals to the Arduino uno The Arduino uno is connected with the L289N Controller and IR Sensor

Then the Arduino uno gives the signals to the L289N Controller. L289N Controller steps up the voltage with the help of a battery which is connected parallel to the Controller and gives to the DC motor for a smooth run. IR Sensor will sense the speed of the DC motor with an encoder which is connected to the wings of the fan of the DC motor to sense the speed of the motor

IR Sensor will sense the speed and will give the signals to the Arduino and Arduino will give the signal to the MATLAB and MATLAB will show the rpm of the motor

The drawings included in this patent application show the schematic diagram of the proposed system and the Simulink model of the FOPID controller.

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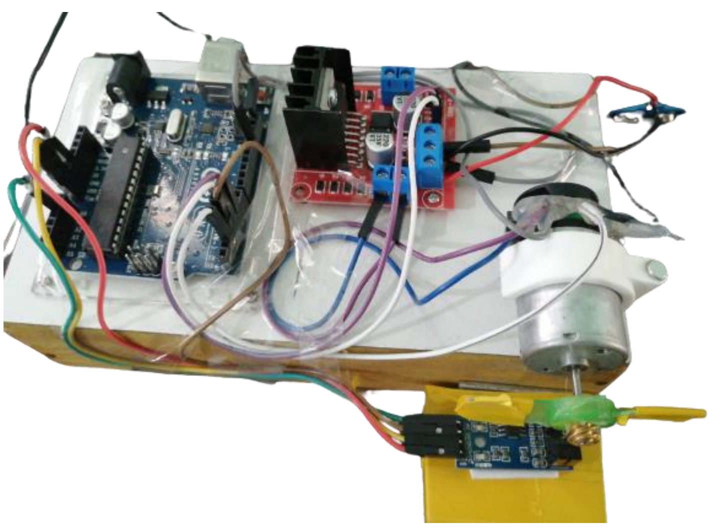
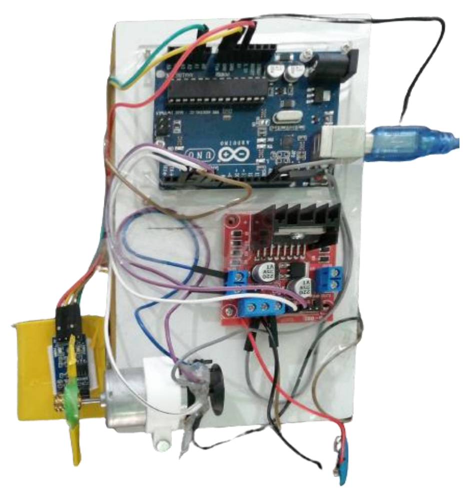
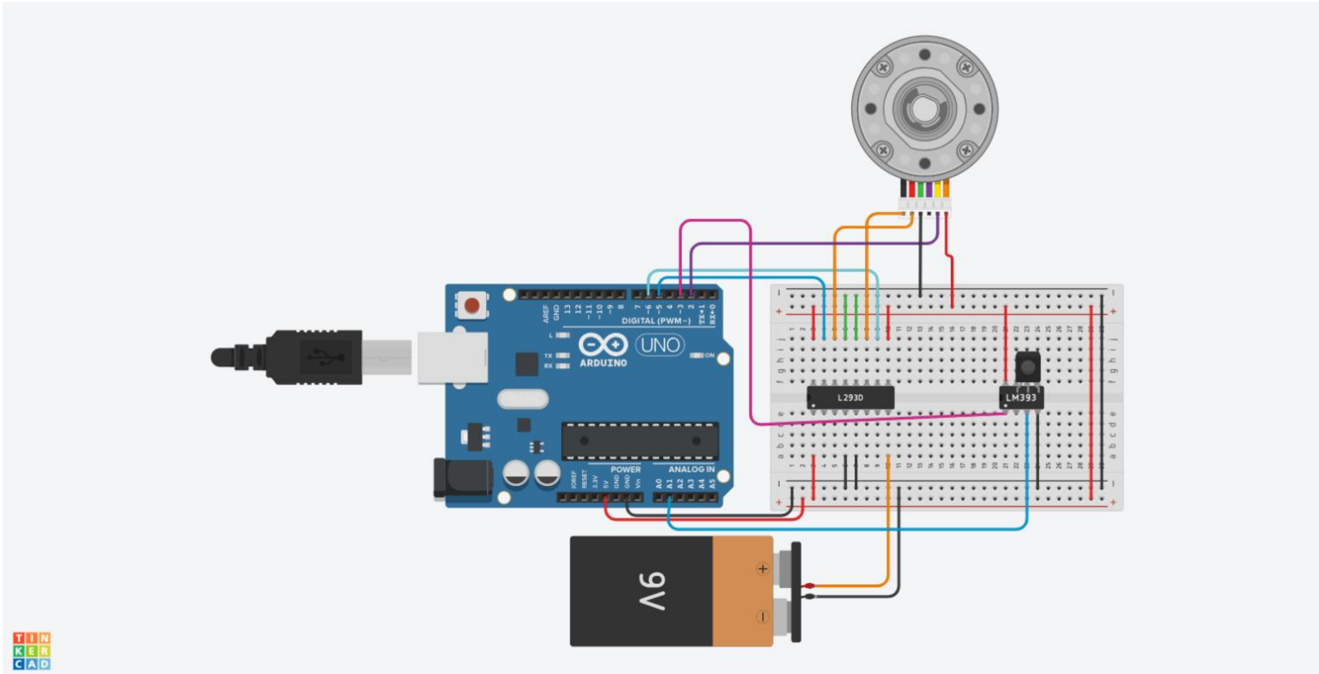
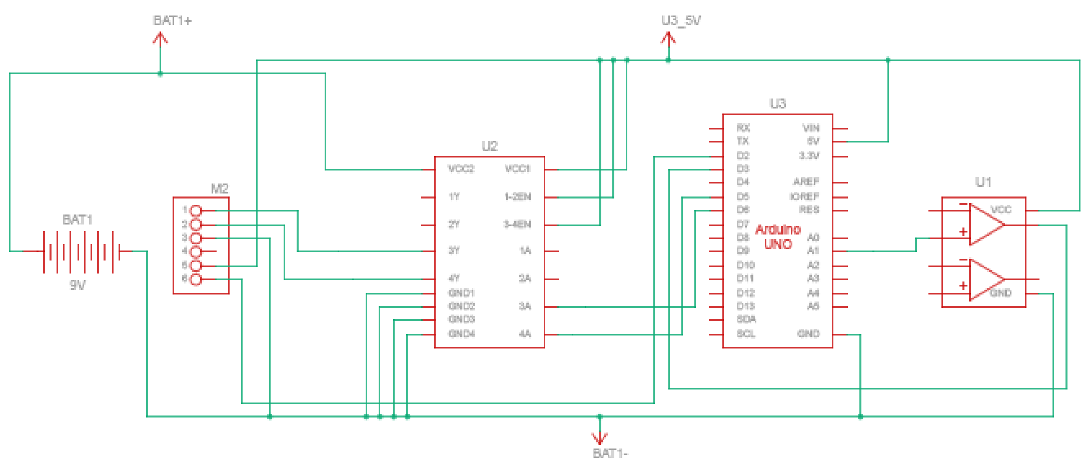
SIMULATION
DEBUG
MODELING
FORMAT
HARDWARE
APPS
SCOPE
Hardware Board
Arduino Uno
Run on board
Hardware Settings
Log Signals
Add Viewer
Stop Time
inf
Monitor & Tune
Data Inspector
Logic Analyzer
Build, Deploy & Start
HARDWARE BOARD
MODE
PREPARE
RUN ON HARDWARE
REVIEW RESULTS
DEPLOY
Hardware Realization FPI Fractional Order
DashBoard
PWM Gauge
RPM Slider
RPM Gauge
Scope
From7:1
RPM
PWM_Output
PWM
Guided by-
Dr. Sunil Nangrani
Ready
79%
FixedStepAuto







ARDUINO
UNO
DIGITAL (PWM~)
POWER
ANALOG IN
L293D
LM393
9V
TINKERCAD



BAT1+
U3_5V
U3
U2
M2
BAT1
9V
U1
VCC2
VCC1
1Y
1-2EN
2Y
3-4EN
3Y
1A
4Y
2A
GND1
GND2
3A
GND3
GND4
4A
RX
TX
D2
D3
D4
D5
D6
D7
D8
D9
D10
D11
D12
D13
SDA
SCL
VIN
5V
3.3V
AREF
IOREF
RES
A0
A1
A2
A3
A4
A5
GND
Arduino
UNO
VCC
GND
BAT1-

Detail description of the invention:

Hardware Realization FPI Fractional Order is used MATLAB as a means for operation. All the Controls of dc motor with encoder are managed by Arduino Uno microcontroller. The product aims to integrate of IR sensors, L298N, a DC motor with an Encoder, Fan, Arduino Cable, to achieve multidimensional functionality in a DC Motor with an Encoder using MATLAB.

The major components used in our product are:

1) Arduino Uno

The Arduino UNO is an AT mega 328-based microcontroller. The operating voltage of the controller board is 5 volts. It's operating voltage ranges from 7 to 20 volts. It consists of 14 Digital input output pins of which 6 pins of which 6 pins provide PWM output. There are 6 analog input pins with DC current 20mA. It also has a 3.3V source pin that requires 50mA direct current. The vital part of the controller flash memory of 32KB. It also includes SRAM of 2KB and EPROM of 1KB having clock speed of 16MHz. The dimensions of the Arduino are 68.6mm in length, and 53.4mm in width. It weighs around 25g

2) IR Sensor

Infra-Red sensor is used to detect the presence of an object within its vicinity. IR sensor involves the use of light sensor to detect a single light wavelength in the Infrared Spectrum. The intensity of light is recorded by comparing the light emitted by the LED and the wavelength expected by sensor. Light emitted by the LED is reflected from the object and then into the light sensor. This creates a momentous change in intensity, which indicates the presence of an object. This sensor provides logical “1” output denoting 97% presence of an object and logical “0” output in the absence of the object.

3) DC Motor With Encoder

DC motor encoders are used for speed control feedback in DC motors where an armature or rotor with wound wires rotates inside a magnetic field created by a stator. The DC motor encoder provides a mechanism to measure the speed of the rotor and provide closed-loop feedback to the drive for precise speed control.

4) L289N:

The L298N chip contains two standard H-bridges capable of driving a pair of DC motors, making it ideal for building a two-wheeled robotic platform. The L298N motor driver has a supply range of 5V to 35V and is capable of 2A continuous current per channel, so it works very well with most of our DC motors.

Best Method of Performance of Invention:

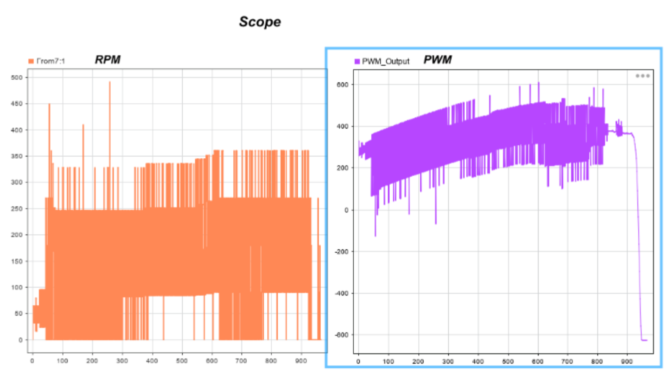
The best method of performance of the invention is to first tune the parameters of the FOPID controller. This can be done using a variety of methods, such as manual tuning or genetic algorithms. Once the parameters have been tuned, the system can be used to control the speed of the DC motor by simply setting the desired speed on the dashboard.

Fpi Fractional Order is the main component of our project. FPI Fractional Order Controller is used in MATLAB for controlling the dc motor with an encoder using Arduino. Firstly, we made a Simulink model in MATLAB be using FPI controller to control the dc motor.

When we run the Simulink model in the MATLAB Simulink it will give the signal to the Arduino uno. Arduino is connected to the L289N Controller and with the Ir sensor and the pins of the encoder. Firstly, Arduino will give signals to the L289N Controller and this controller will step up the voltage with the help of the battery and give the voltage to the motor for a smooth run.

The Ir sensor is used to count the rotation of the motor means the rpm of the motor and gives the signal to the Arduino. And Arduino uno helps Matlab to show the rpm in the Simulink model

Results:



CLAIMS:

MATLAB and Simulink model working real-time control and visualization monitoring of DC motor for implementing a Fractional-Order Proportional-Integral (FPI) controller.

ABSTRACT:

This invention discloses a hardware system for implementing FOPID control for DC motor speed control. The system includes an Arduino Uno microcontroller, an L298N motor driver, an IR sensor, and a DC motor with an encoder. The system is controlled by a software component implemented in MATLAB Simulink, which includes a dashboard for visualizing and controlling the system in real-time.

The system was evaluated by controlling the speed of a DC motor with an encoder. The results showed that the system can control the speed of the DC motor accurately and precisely. The system also demonstrated the benefits of using FOPID control for DC motor control, such as improved tracking performance and reduced overshoot.

The system can be used in a variety of applications, such as industrial automation, robotics, and automotive engineering. Electrochemical Processes Biomedical Engineering Viscoelastic Materials Oil Reservoir Engineering Control of Complex Systems