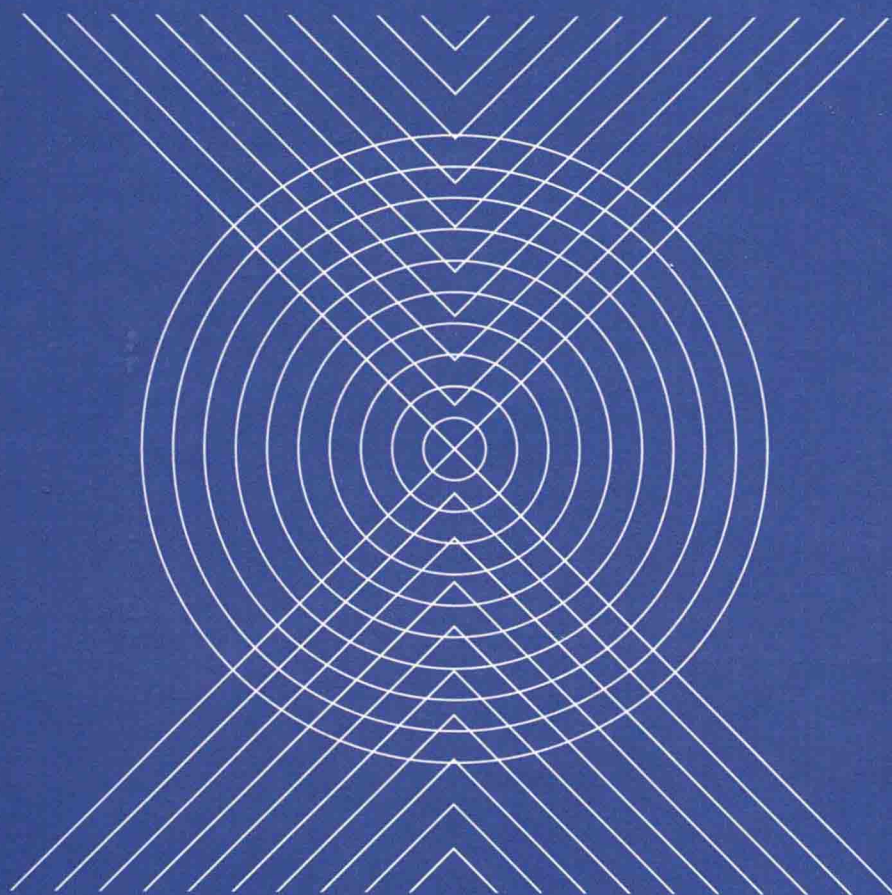


# Electrical, Control Engineering and Computer Science

Editor: Liu Jian



PROCEEDINGS OF THE 2015 INTERNATIONAL CONFERENCE ON ELECTRICAL, CONTROL  
ENGINEERING AND COMPUTER SCIENCE (ECECS 2015), HONG KONG, 30–31 MAY 2015

# Electrical, Control Engineering and Computer Science

*Editor*

**Jian Liu**

*School of Electrical and Information Engineering,  
Wuhan Institute of Technology, Wuhan, China*



**CRC Press**

Taylor & Francis Group

Boca Raton London New York Leiden

---

CRC Press is an imprint of the  
Taylor & Francis Group, an **informa** business

**A BALKEMA BOOK**

*CRC Press/Balkema is an imprint of the Taylor & Francis Group, an informa business*

© 2016 Taylor & Francis Group, London, UK

Typeset by V Publishing Solutions Pvt Ltd., Chennai, India

All rights reserved. No part of this publication or the information contained herein may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, by photocopying, recording or otherwise, without written prior permission from the publisher.

Although all care is taken to ensure integrity and the quality of this publication and the information herein, no responsibility is assumed by the publishers nor the author for any damage to the property or persons as a result of operation or use of this publication and/or the information contained herein.

Published by: CRC Press/Balkema  
P.O. Box 11320, 2301 EH Leiden, The Netherlands  
e-mail: [Pub.NL@taylorandfrancis.com](mailto:Pub.NL@taylorandfrancis.com)  
[www.crcpress.com](http://www.crcpress.com) – [www.taylorandfrancis.com](http://www.taylorandfrancis.com)

ISBN: 978-1-138-02937-8 (Hbk)  
ISBN: 978-1-315-63882-9 (eBook PDF)





## Preface

The 2015 International Conference on Electrical, Control Engineering and Computer Science (ECECS2015) was successfully held in Hong Kong, May 30–31, 2015. The ECECS2015 was organized by the American Society of Science and Engineering (ASEE). The ASEE is a non-profit society for engineers and scientists, which was founded originally in 2009 and has been undergoing rapid expansion in the recent years. The ECECS2015 is co-sponsored by Chongqing University of Science and Technology, The Hong Kong Polytechnic University, MVGR College of Engineering, Babol University of Technology, Helwan University, Xi'an Jiaotong-Liverpool University, and North China Electrical Power University. The ECECS conference serves as an excellent platform for the engineering and science community to meet with each other and to exchange theories, ideas, techniques and experiences related to all aspects of electrical engineering, control engineering and computer science.

This book contains 39 revised and extended research articles, written by prominent researchers participating in the conference. Topics covered include electrical engineering, control engineering, communication and computer networks, and computer science. All accepted papers went through strict peer-reviewing by 2–4 expert referees and the overall acceptance rate was 38.9%. The papers have been selected for this book because of quality and the relevance to the conference. The organizing committee of ECECS2015 would like to express our sincere appreciations to all authors for their contributions to this book. We would like to extend our thanks to all the referees for their constructive comments on all papers; especially, we would like to thank to organizing committee for their hard working.

Prof. Jian Liu  
*General Chair of ECECS2015*  
*Wuhan Institute of Technology*



## Table of contents

Preface	ix
<i>Electrical and control engineering</i>	
Structural design and motion simulation of a kind of AMT Clutch Actuator <i>Y.F. Zhang</i>	3
Comparative study of electrical characteristics in southern, central, and northern areas of Jiangsu province <i>C.-C. Jiang, P.-H. Wang &amp; Y.-S. Hao</i>	7
The change rule of line loss rate based on the marketing data of the stable districts in Jiangsu province <i>J.-L. Xu, Y.-F. Zou &amp; Y.-P. Kong</i>	11
A comparative study of mode-space transform and array interpolation for DOA estimation of coherent signals in fourth-order cumulant domain <i>M.H. Liu, S.W. Gao &amp; J.H. Yin</i>	15
Adaptive low-voltage ride-through of DFIG based on crowbar with PDR and unloading protection circuit <i>H.L. Jiang, Z. Jiang, X. An &amp; J.P. Wang</i>	21
Research on the influence of load rate on district line loss rate in different areas of Jiangsu province <i>G.-D. Gu</i>	25
Fault tolerant synchronization of chaotic system with sampled-data controller <i>T. Ren, Y.J. Xu, M.M. Liu, J.-X. Wen &amp; S. He</i>	29
Multi-interval schedule of economic dispatch for cogeneration systems <i>M.-T. Tsai, F.-S. Chen &amp; C.-C. Lo</i>	33
Fault location algorithm based on fault region determination for partial coupling four-circuit transmission lines <i>W.M. Luo, H.Q. Wang, J.H. Wang, L. Zeng, S.Y. Chen, L. Xiao &amp; W.L. Du</i>	39
Online identification based stability index in Multi-Send HVDC power transmission system <i>S. Zhang, F. Gao, B. Tian, Y.F. Wang &amp; C. Lu</i>	47
Stability analysis of hybrid AC/DC micro-grid <i>H. Pan, M. Ding, L.G. Tian, X.S. Zhang &amp; X.H. Ge</i>	53
Plasma slab's electromagnetic behavior calculation based on two Auxiliary Differential Equation (ADE) styles <i>J.Z. Ji, H.Q. Wu &amp; P.L. Huang</i>	59
The electromagnetic equivalent modeling and simulation analysis of large size metal structure <i>P.H. Xie, J.S. Yuan &amp; J.J. Bi</i>	63
Transmission characteristics of Quadruple-Ridge Square Waveguide loaded with right-handed and left-handed materials <i>G.J. Li, Y.Q. Cheng &amp; A.N. Ma</i>	69



A moving target collaborative tracking algorithm based on dynamic fuzzy clustering <i>J. Xiong, Z.J. Liu, G.L. Tang, H.M. Xue &amp; J. Wang</i>	73
Research on the bacon key-quality based on physical detection and hyperspectral image of full-scale features <i>P.-Y. Guo, M. Bao, K.-C. Yang &amp; S. Liu</i>	77
Study of eddy current brake based on motion of Permanent Magnet in the nonmagnetic metal tube <i>Y.X. Xia, S.M. Yan, H.N. Tan, W. Song, S.Y. Yang &amp; W. Chen</i>	83
On-line dissolved gas analysis monitor based on laser photoacoustic spectroscopy <i>J.B. Huang, J.M. Tan &amp; L. Di</i>	89
The third-order Absorbing Boundary Condition for finite difference modeling of first-order stress-velocity acoustic equation <i>P. Song, J. Tan, D.M. Xia, J. Li, Z.L. Liu &amp; B. Zhu</i>	93
Automatic vertical parking steering control based on fuzzy control and Extended Kalman Filter <i>X.W. Ji, S. Sun &amp; Y. Huang</i>	97
Fault diagnosis for transmission network based on Timing Bayesian Suspected Degree <i>X.F. Ma, Q. Chen &amp; Z.J. Gao</i>	103
Combining region-based model with geodesic active contour for nature image segmentation using graph cut optimization <i>L. Song, M.T. Gao &amp; S.M. Wang</i>	107
<i>Computer science</i>	
Research and implementation of automobile ECU bootloader self-update <i>J. Zhang, X.Y. Zhu &amp; Y. Peng</i>	117
An embedded web server for remote monitoring of rice whiteness <i>K. Kanjanawanishkul, J. Chinnakotr &amp; W. Promwang</i>	125
Detection of gene deletion based on machine learning <i>Y. Zhao, J.Y. Gao, F. Qi &amp; R. Guan</i>	131
Multiple-range query processing in Main Memory Column Store <i>H. Liu, Z.J. Liu, T. Yuan &amp; J. Wang</i>	137
A high-efficiency sorting algorithm on multi-core <i>X. Huang, Z.J. Liu &amp; T. Yuan</i>	143
A new scheme of OPGW melting ice and its efficiency <i>Y.Q. Lei, X. Chen, Y. Wang &amp; B.S. Hou</i>	147
Research on the login system of double authentication based on fingerprint and password <i>X.Q. Wang, Y. Li, X. Yuan, C.X. Zhang &amp; S.L. Wang</i>	151
Efficient adaptive merging indexing for multi-core CPUs <i>T. Yuan, Z.J. Liu, H. Liu &amp; X. Huang</i>	155
Two-dimensional Compressed Sensing for IR-UWB Wireless Sensor Network data <i>Y.L. Liu, K. Wang, B. Zhang &amp; S. Xu</i>	159
The intermediate classification of hyperplane detection method for clustering SVM <i>S.F. Gong, C. Liang &amp; X.R. Bi</i>	163
Computer simulation on aerodynamic design of waverider vehicle <i>L. Luo &amp; S.-L. Gao</i>	169

<i>Communication and computer networks</i>	
Multiple faults localization theory for transparent all optical networks <i>Y.J. Li, X. Li &amp; Y. Wang</i>	175
Study on characteristics of Channel Plasmon Polariton Waveguides by the improved coupled mode theory <i>A.N. Ma, Y.E. Li, Y.Z. Wang &amp; G.J. Li</i>	179
Interference performance analysis for Device-to-Device system with multi-antenna destination underlying cellular networks <i>M.M. Gao, S.X. Shao &amp; J. Sun</i>	183
Channel estimation of IEEE 802.11ah based on traveling pilot and compressive sensing <i>Y. Wang, Y.Z. Li &amp; J.G. Hu</i>	187
Design and implementation of embedded network communication system based on RT-thread and LwIP <i>L.F. Huang, N.G. Chen, L. Y. Huang &amp; H.Z. Lin</i>	191
The hardware decoding implementation of video surveillance based on Android system <i>S.K. Liu, L. Cao, Z. Y. Shi &amp; C. Feng</i>	195
Author index	199



*Electrical and control engineering*



# Structural design and motion simulation of a kind of AMT Clutch Actuator

Yanfang Zhang

Chongqing College of Electronic Engineering, China

**ABSTRACT:** Taking the AMT Clutch Actuator of an experimental platform of a kind of full hybrid electric vehicle as an example, we design the structure of the Clutch Actuator, select the type of motor for the Clutch Actuator, design and verify the joint strength of the actuator, and carry out 3D modeling and motion simulation of the Clutch Actuator in this paper.

**Keywords:** Clutch Actuator; structural design; verification; motion simulation

## 1 INTRODUCTION

As an important component of the mechanical transmission system of the vehicle, the clutch has functions of transmitting torques, absorbing shocks, resisting torsions, disengaging and jointing, etc. [1–2] The requirements for the design of the clutch are as follows: the clutch realizes the smooth jointing between the engine and the transmission making the vehicle start smoothly; breaks off the connection between the engine and the transmission system quickly reducing the impacts between the gears of the transmission and making the shifting easy; protects the transmission system from impact and destruction when suffering heavy dynamic loads during working. [3] In this paper, we design an AMT Clutch Actuator of which the driving mode is electronically controlled and electrically powered.

## 2 STRUCTURAL DESIGN OF THE CLUTCH ACTUATOR

The working process of the Clutch Actuator is: firstly, the ECU receives the shifting command

according to the driver's intention and the real situation of the vehicle. Then the ECU controls the motor, and the motor drives the linear module, and the layer board on the linear module moves, driving the push-pull rod on it, which controls the piston of the main hydraulic cylinder which connects with a liquid storage cylinder to move towards the left or the right to adjust the pressure in the main hydraulic cylinder. The push of the piston in the main hydraulic cylinder makes the pressure in the oil passage on the right side of the main cylinder change, which produces a push-pull force to the clutch, and makes it meet the requirements for control. The structure of the actuator is shown in Figure 1.

## 3 THE DESIGN AND VERIFICATION OF THE CLUTCH CONTROL ACTUATOR

According to the experimental data of the experimental bench model, the complete disengaging time of the clutch should be less than 0.4 s, and the maximum pressure of the front-end hydraulic cylinder of the clutch is 0.8 MPa, so the design

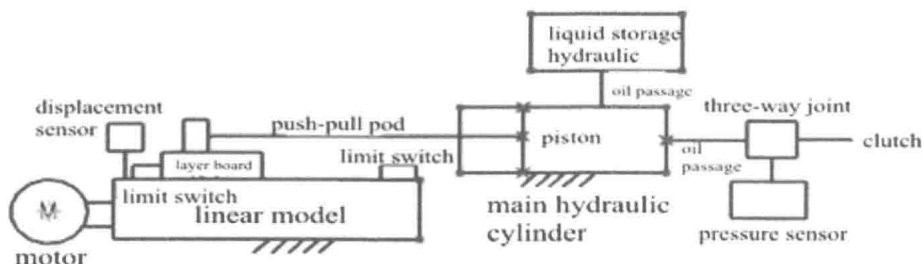


Figure 1. Simplified model for engine mounting.

of the actuator should meet the requirements of the maximum disengaging speed and the strength under the corresponding disengaging pressure. [4–5]

### 3.1 Selection of the motor type of the Clutch Actuator

In order to control the jointing speed and displacement of the clutch more accurately, we select the stepping motor. Subdivision control is adopted, so the developed control accuracy of the stroke displacement of the clutch can achieve 0.025 mm. According to the known conditions, the maximum pressure of the front-end hydraulic cylinder of the clutch is 0.8 MPa, and the diameter of the piston in the hydraulic cylinder of the actuator is 16 mm, so the following can be obtained based on this.

$$F_{\max} = P_{\max} \times A = 160 \text{ N} \quad (1)$$

$F_{\max}$  refers to the maximum push-pull force of the push-pull rod of the actuator;  $A$  refers to the sectional area of the hydraulic cylinder.

The stroke of the clutch is  $L = 30$  mm, the complete disengaging time of the clutch = 0.4 s. So the linear speed of the push-pull rod can be obtained.  $v = L/t = 0.075$  m.

According to the calculations of the above formulas, the parameters of the driving motor of the Clutch actuator can be calculated. the power of the driving motor of the clutch:  $P = F_{\max} \times V$ , which is calculated to be 12 W.

According to the calculated motor power, we select the Y200 L 1–2 stepping motor with a power of 30 W and a revolving speed of 2950 rpm. The front end of the push-pull rod is driven by a screw. Use the M10 × 0.5 metric fine screw thread for screw drive.

### 3.2 Design and verification of the actuator's connection strength

Use two M8 bolts initially for the threaded connection between the hydraulic cylinder and the guide plate. Bolts are being pulled. The bolts are under pre-tightening force and operating pulling force. Considering that they may need additional tightening under the total pulling force, thereby the strength condition of the bolt here is:

$$\sigma_e = \frac{5.2F_{\max}}{\pi d_1^2} \leq [\sigma] \quad (2)$$

In the formula,  $d_1$  is the diameter of the bolt which is 8 mm. Induced it into calculation and the

conclusion is  $\sigma_e = 4.14 \text{ MPa} < [\sigma] = 36 \text{ MPa}$ , so the connection is safe.

Select M8 bolt initially for the threaded connection between the short axis and inhaul cable, and shear the bolt. The shear-resisting strength condition of the bolt is:

$$\tau = \frac{4F_{\max}}{\pi d_0^2 m} \leq [\tau] \quad (3)$$

In the formula,  $m$  is the bolt shank's shearing area, and  $m = 2$ ;  $d_0$  is the diameter of the bolt shank's shearing area, and  $d_0 = 8$  mm. Induced it into calculation, and the conclusion is  $\tau = 1.59 \text{ MPa} \leq [\tau] = 45 \text{ MPa}$ , so the shear strength is safe. The extruding strength condition for the surface of the contact area between bolt shank and the wall of hole is:

$$\sigma_p = \frac{F_{\max}}{d_0 h} \leq [\sigma_p] \quad (4)$$

In the formula,  $h$  is the minimum height of the extruding area between bolt shank and the wall of hole, and  $h = 6$  mm. Induce it into calculation, and the conclusion is  $\sigma_p = 3.33 \text{ MPa} \leq [\sigma_p] = 90 \text{ MPa}$ , so the extruding strength is safe.

The connection between the short axis and the layer board select two M6 bolts initially for connecting, and shear the bolts. The shear strength condition is as formula (3). In the formula,  $m = 1$ . Induce it into calculation, and the conclusion is  $\tau = 5.66 \text{ MPa} \leq [\tau] = 45 \text{ MPa}$ , Extruding strength condition is as formula (4). In the formula,  $h = 13.5$  mm. Induce it into calculation, and the conclusion is  $\sigma_p = 0.99 \text{ MPa} \leq [\sigma_p] = 90 \text{ MPa}$ , so the bolt connection here is safe.

## 4 3D MODELING AND SIMULATION OF THE CLUTCH ACTUATOR'S

### 4.1 Overall model of the Clutch Actuator

This article uses UG N6.0 for Clutch Actuator's 3D solid modeling, and adopts the top-down method to design the assembly. The specific design scheme, mechanism schematics and specific parameters of the clutch operating mechanism have all been explained in detail in the preceding text. Next is the modeling and simulation of the mechanism. The overall model of Clutch Actuator is shown in Figure 2. In this overall model, each component's screw bolt and screw thread connection are left out, only indicated with circular holes, and are replaced with constraint order.

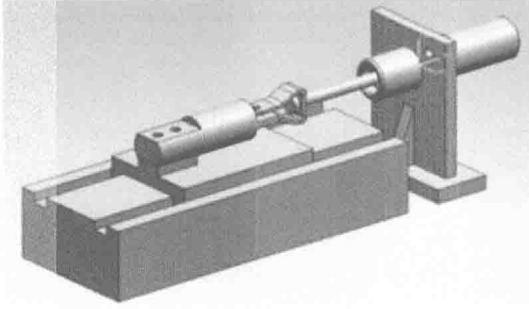


Figure 2. Overall model of Clutch Actuator.

#### 4.2 Simulation analysis of the Clutch Actuator

Mechanism motion analysis module [motion], which is UG NX6.0 self-carried, provides mechanism simulation analysis and text production function. With a three-dimensional model of Clutch Actuator having been set up in the preceding text, the simulation analysis now follows.

Operate UG NX, open the set-up actuator mechanism model, and select [start]/[motion simulation] in the menu. Then single-click the right key in the assembly model of motion navigation, select [create a simulation] to create a simulation, and with a [motion-1] acquired, it enters the motion simulation mode.

First of all, assign link rods. Single-click the right key on [motion-1] to create link rods. With the link rods created, each independent space link rod has six degrees of freedom, and we need connect the link rods with kinematic pairs, which will form a certain constraint among the link rods, making the motion chain that is made up of the link rods have a definite motion, so as to create a mechanism.

Next, set up the sliding pair. Right-click on [motion-1] and then choose the sliding pair in the drop-down box of [create a new kinematic pair]. Later choose the connecting rod that needs to move. Using the line or the plane in its direction of motion as the chosen object can directly generate the kinematic pair, after which you can choose the direction of motion. Later, choose the truck mode

to be function in the driver dialog. Then choose the function manager to create a new function. Choose the motion function in the box after inserting. Create a STEP function and the body of this STEP function is STEP (time, 0, 0, 0.4, 60) + STEP (time, 0.4, 0, 1.4, 0) + STEP (time, 1.4, 0, 1.8, -60).

When the connecting rod and the kinematic pair are available, create a new budget scheme. What needs to be noticed is that the number of steps should be set to 1000 steps, which is beneficial to the observation of the simulation result. When the system settlement is finished, the simulation animation is available, verifying the rationality of the clutch control actuator.

## 5 CONCLUSION

This paper introduces a AMT Clutch Actuator applied to full hybrid electric vehicle experimental platforms. It carries out design calculation and strength check and gets the basic structure and dimensions. It uses UG NX6.0 to design the structure and generates the three-dimensional model of AMT Clutch Actuator and conducts motion simulation in the end, verifying the rationality of this clutch control actuator.

## REFERENCES

- [1] Wang Xiaochuang, Tang Guangdi et al. Research on A Kind of Hybrid Power Motor Automatic Clutch Actuator [J]. Mechanical Drive, 2013.
- [2] Lun, Cheng Xiusheng, Ge Anlin, et al. Clutch Control in the Process of AMT Shifting [J]. Automobile Technology, 2006.
- [3] Tian Ye. AMT Automatic Shifting Speed Control System Design [J]. Shanxi Electronic Technology, 2009.
- [4] Zhang Hui, Liu Zhenjun, Qin Datong. Heavy Duty Motor AMT Hydraulic Shifting Executing Agency Analysis and Design [J]. Hydraulic and Pneumatic, 2007.
- [5] Jin Long. AMT Electric Clutch Actuator Dynamic Property Simulation Research [D]. Jilin University, 2007.



