

KINEMATICS OF MACHINES

VELOCITY ANALYSIS

In a four link mechanism, the dimension of the links are as under, $AB = 50 \text{ mm}$, $BC = 58 \text{ mm}$, $CD = 55 \text{ mm}$ and $AD = 100 \text{ mm}$. At the instant when $\angle DAB = 60^\circ$, the link AD has an angular velocity of 10.5 rad/sec in the counter clockwise direction. Determine

1. Velocity of Point C.
2. Velocity of Point E on the link BC, when $BE = 40 \text{ mm}$.
3. The angular velocities of the link BC and CD.
4. The velocity of an offset point "F" in link BC if $BF = 45 \text{ mm}$, $CF = 30 \text{ mm}$ and BCF is read clockwise.
5. The velocity of an offset point "G" on the link CD if $CG = 24 \text{ mm}$, $DG = 44 \text{ mm}$ and DCG is read clockwise.

Scale: $0.525 \text{ m/s} = 50 \text{ mm}$

mps to length: $1 \text{ m/s} = 95.24 \text{ mm}$

Length to mps: $1 \text{ mm} = 0.0105 \text{ m/s}$

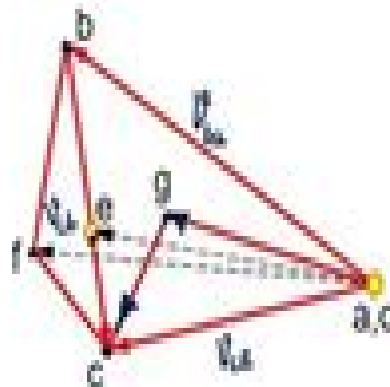
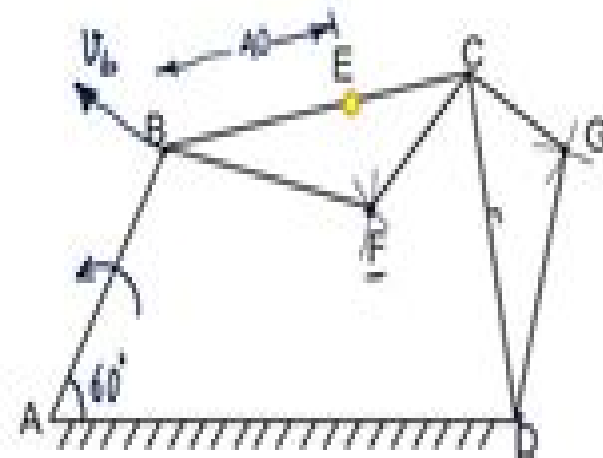
$$\theta = \omega r$$

$$\omega = \frac{\theta}{r}$$

$$\omega_{AD} = 10.5 \text{ rad/sec}, \quad v_{B/A} = \omega_{AD} \cdot r_{AB}$$

$$= 10.5 \times 0.05$$

$$= 0.525 \text{ m/s}$$



1. Velocity of Point C $v_C = \omega_{AD} \cdot r_{AC} = 38 \text{ mm}$
 $= (38 \times 0.0105) \text{ m/s}$
 $= 0.4 \text{ m/s}$

2. Velocity of Point E on the link BC, when $BE = 40 \text{ mm}$

$$\frac{v_E}{v_C} = \frac{BE}{BC} \Rightarrow v_E = \frac{40}{58} \times 32 = 19.39 \text{ mm}$$

$$v_E = \omega_{BC} \cdot r_{BE} = 39 \text{ mm} = (39 \times 0.0105) \text{ m/s}$$

$$= 0.41 \text{ m/s}$$

3. The angular velocities of the link BC and CD

$$\omega_{BC} = \frac{v_E}{r_{BE}} = \frac{32 \times 0.0105}{0.066} = 5.09 \text{ rad/sec}$$

$$\omega_{CD} = \frac{v_G}{r_{CG}} = \frac{38 \times 0.0105}{0.056} = 7.125 \text{ rad/sec}$$

4. The velocity of an offset point "F"

$$v_F = \omega_{BC} \cdot r_{BF} = 48 \text{ mm} = 48 \times 0.0105 = 0.504 \text{ m/s}$$

5. The velocity of an offset point "G"

$$v_G = \omega_{CD} \cdot r_{CG} = 30 \text{ mm} = 30 \times 0.0105 = 0.315 \text{ m/s}$$

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Kinematics Analysis Of Mechanisms Methods And:

Kinematic Analysis and Synthesis of Mechanisms Asok Kumar Mallik, Amitabha Ghosh, Gunter Ditttrich, 2021-09-30
This text reference represents the first balanced treatment of graphical and analytical methods for kinematic analysis and synthesis of linkages planar and spatial and higher pair mechanisms cams and gears in a single volume format A significant amount of excellent German literature in the field that previously was not available in English provides extra insight into the subject Plenty of solved problems and exercise problems are included to sharpen your skills and demonstrate how theory is put into practice

THEORY OF MECHANISMS AND MACHINES C. S. SHARMA, KAMLESH PUROHIT, 2006-01-01
Intended to cater to the needs of undergraduate students in mechanical production and industrial engineering disciplines this book provides a comprehensive coverage of the fundamentals of analysis and synthesis kinematic and dynamic of mechanisms and machines It clearly describes the techniques needed to test the suitability of a mechanical system for a given task and to develop a mechanism or machine according to the given specifications The text develops in addition a strong understanding of the kinematics of mechanisms and discusses various types of mechanisms such as cam and follower gears gear trains and gyroscope

Machines and Mechanisms David H. Myszka, 2005 Provides the techniques necessary to study the motion of machines and emphasizes the application of kinematic theories to real world machines consistent with the philosophy of engineering and technology programs This book intends to bridge the gap between a theoretical study of kinematics and the application to practical mechanism

Mechanism Analysis Lyndon O. Barton, 2016-04-19 This updated and enlarged Second Edition provides in depth progressive studies of kinematic mechanisms and offers novel simplified methods of solving typical problems that arise in mechanisms synthesis and analysis concentrating on the use of algebra and trigonometry and minimizing the need for calculus It continues to furnish complete coverage

Mechanism and Machine Theory J. S. Rao, Rao V. Dukkipati, 2007 This Book Evolved Itself Out Of 25 Years Of Teaching Experience In The Subject Moulding Different Important Aspects Into A One Year Course Of Mechanism And Machine Theory Basic Principles Of Analysis And Synthesis Of Mechanisms With Lower And Higher Pairs Are Both Included Considering Both Kinematic And Kinetic Aspects A Chapter On Hydrodynamic Lubrication Is Included In The Book Balancing Machines Are Introduced In The Chapter On Balancing Of Rotating Parts Mechanisms Used In Control Namely Governors And Gyroscopes Are Discussed In A Separate Chapter The Book Also Contains A Chapter On Principles Of Theory Of Vibrations As Applied To Machines A Solution Manual To Problems Given At The End Of Each Chapter Is Also Available Principles Of Balancing Of Linkages Is Also Included Thus The Book Takes Into Account All Aspects Of Mechanism And Machine Theory To The Reader Studying A First Course On This Subject This Book Is Intended For Undergraduate Students Taking Basic Courses In Mechanism And Machine Theory The Practice Of Machines Has Been Initially To Use Inventions And Establishment Of Basic Working Models And Then Generalising The Theory And Hence The Earlier Books Emphasises These Principles With The Advancement Of

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proceedings of the 2022 International Conference on New Materials Machinery and Vehicle Engineering NMMVE 2022 held as a virtual event due to the COVID 19 pandemic and travel restrictions from 18 20 March 2022 NMMVE 2022 provides an international forum for researchers and engineers to present and discuss recent advances new techniques and applications in the fields of new materials machinery and vehicle engineering and attracts academics scientists engineers postgraduates and other professionals from a wide range of universities and institutions A total of 121 submissions were received from which 48 were accepted for inclusion in the conference and proceeding after a rigorous standard single blind reviewing process The papers are grouped into 3 sections machinery 30 papers new materials 11 papers and vehicle engineering 7 papers Providing an overview of the latest developments in these fields the book will be of interest to all those wishing to know more about new materials and machine and vehicle engineering

Recent Advances in Mechanical Infrastructure Ajit Kumar Parwani, PL. Ramkumar, Kumar Abhishek, Saurabh Kumar Yadav, 2021-03-01 This book contains high quality papers presented in the conference Recent Advances in Mechanical Infrastructure ICRAM 2020 held at IITRAM Ahmedabad India from 21 23 August 2020 The topics covered in this book are recent advances in thermal infrastructure manufacturing infrastructure and infrastructure planning and design

Advances in Mechanism and Machine Science Tadeusz Uhl, 2019-06-13 This book gathers the proceedings of the 15th IFToMM World Congress which was held in Krakow Poland from June 30 to July 4 2019 Having been organized every four years since 1965 the Congress represents the world s largest scientific event on mechanism and machine science MMS The contributions cover an extremely diverse range of topics including biomechanical engineering computational kinematics design methodologies dynamics of machinery multibody dynamics gearing and transmissions history of MMS linkage and mechanical controls robotics and mechatronics micro mechanisms reliability of machines and mechanisms rotor dynamics standardization of terminology sustainable energy systems transportation machinery tribology and vibration Selected by means of a rigorous international peer review process they highlight numerous exciting advances and ideas that will spur novel research directions and foster new multidisciplinary collaborations

Intelligent Robotics and Applications Xuguang Lan, Xuesong Mei, Caigui Jiang, Fei Zhao, Zhiqiang Tian, 2025-01-23 The 10 volume set LNAI 15201 15210 constitutes the proceedings of the 17th International Conference on Intelligent Robotics and Applications ICIRA 2024 which took place in Xi an China during July 31 August 2 2024 The 321 full papers included in these proceedings were carefully reviewed and selected from 489 submissions They were organized in topical sections as follows Part I Innovative Design and Performance Evaluation of Robot Mechanisms Part II Robot Perception and Machine Learning Cognitive Intelligence and Security Control for Multi domain Unmanned Vehicle Systems Part III Emerging Techniques for Intelligent Robots in Unstructured Environment Soft Actuators and Sensors and Advanced Intelligent and Flexible Sensor Technologies for Robotics Part IV Optimization and Intelligent Control of Underactuated Robotic Systems and Technology and application of modular robots Part V Advanced actuation and intelligent control in

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Talpasanu,2019-08-08 Mechanics of Mechanisms and Machines provides a practical approach to machine statics kinematics and dynamics for undergraduate and graduate students and mechanical engineers The text uses a novel method for computation of mechanism and robot joint positions velocities accelerations and dynamics and statics using matrices graphs and generation of independent equations from a matroid form The computational methods presented can be used for industrial and commercial robotics applications where accurate and quick mechanism robot control is key The book includes many examples of linkages cams and geared mechanisms both planar and spatial types having open or multiple cycles Features Presents real world examples to help in the design process of planar and spatial mechanisms Serves as a practical guide for the design of new products using mechanical motion analysis Analyzes many applications for gear trains and auto transmissions robotics and manipulation and the emerging field of biomechanics Presents novel matrix computational methods ideal for the development of efficient computer implementations of algorithms for control or simulation of mechanical linkages cams and geared mechanisms Includes mechanism animations and result data tables as well as comparisons between matrix based equation results implemented using Engineering Equation Solver EES and results for the same mechanisms simulated using SolidWorks *Advances in Mechanism and Machine Science and Engineering in China* Yan Chen,Lujiang Liu,Xinjun Liu,Haitao Liu,Ming Li,Tao Sun,2025-05-13 This book collects selected papers of the 24th IFToMM China International Conference on Mechanism and Machine Science and Engineering CCMMS 2024 CCMMS was initiated in 1982 and it is the most important forum held in China for exchange of research ideas presentation of technical and scientific achievements and discussion of future directions in the field of mechanism and machine science The topics include theoretical and computational kinematics dynamics and control engines and transmission systems parallel hybrid

mechanisms and industrial robotics compliant mechanisms origami mechanisms and soft robotics metamorphic mechanisms and robotics deployable structures and mechanisms aerospace mechanisms and environmental effects micro nano mechanisms and robotics biologically inspired mechanisms and robotics medical and rehabilitation robotics mobile robotics and heavy non road mobile machines history of mechanisms machines and robotics and engineering education on mechanisms This book provides a state of the art overview of current advances in mechanism and machine science in China The inspiring ideas presented in the papers will enlighten the trend in academic research and industrial application The potential readers include academic researchers and industrial professionals in the field of mechanism and machine science

Classical and Modern Approaches in the Theory of Mechanisms Nicolae Pandrea, Dinel Popa, Nicolae-Doru Stanescu, 2017-03-24 Classical and Modern Approaches in the Theory of Mechanisms is a study of mechanisms in the broadest sense covering the theoretical background of mechanisms their structures and components the planar and spatial analysis of mechanisms motion transmission and technical approaches to kinematics mechanical systems and machine dynamics In addition to classical approaches the book presents two new methods the analytic assisted method using Turbo Pascal calculation programs and the graphic assisted method outlining the steps required for the development of graphic constructions using AutoCAD the applications of these methods are illustrated with examples Aimed at students of mechanical engineering and engineers designing and developing mechanisms in their own fields this book provides a useful overview of classical theories and modern approaches to the practical and creative application of mechanisms in seeking solutions to increasingly complex problems

Proceedings of the 5th IEEE/IFTToMM International Conference on Reconfigurable Mechanisms and Robots Fengfeng (Jeff) Xi, Jian S. Dai, Xilun Ding, Volkert van der Wijk, 2021-08-12 The 5th IEEE IFTToMM International Conference on Reconfigurable Mechanisms and Robots ReMAR 2021 was held in Toronto Canada on August 12-14, 2021 at Ryerson University The conference proceedings include more than 70 papers on three main subjects 1 Reconfigurable Mechanisms and Robotics 2 Variable Topology and Morphing Mechanism and 3 Origami and Bio-inspired mechanisms

Fundamentals of Mechanisms and Machines Dhanesh N. Manik, 2024-07-30 This book is all about mechanisms and machines one of the most important core subjects of mechanical engineering There are many ways a mechanism can be configured and there are many mechanisms in a machine creating a tremendous opportunity to build better machines of our choice To do so however one needs to understand the common thread present in the thousands of configurations and to break them down into a set of rules This book does exactly that using the same set of rules consistently to explain the design of any mechanism or machine Pedagogical tools and approaches have been utilized to make it easier and more interesting for the student extensive illustrations simple explanations and exercise problems with useful hints have been included The systematic use of a vector based approach makes learning easier and helps extend the knowledge acquired in this book to applications in robotics

Topology Design of Robot Mechanisms Ting-Li Yang, Anxin

Liu, Huiping Shen, LuBin Hang, Yufeng Luo, Qiong Jin, 2018-01-02 This book focuses on the topology theory of mechanisms developed by the authors and provides a systematic method for the topology design of robot mechanisms. The main original theoretical contributions of this book include:

- A Three basic concepts: The geometrical constraint type of axes is introduced as the third element of the topological structure of a mechanism. When it is combined with the other two elements, the kinematic pair and the connection of links, the symbolic expression of the topological structure is independent of the motion positions except for the singularity positions and the fixed coordinate system.
- Chapter 2: The position and orientation characteristic POC set is used to describe the POC of the relative motion between any two links. The POC set derived from the unit vector set of the velocity of a link is only dependent on the topological structure of a mechanism. Therefore, it is also independent of the motion positions and the fixed coordinate system.
- Chapter 3: The single open chain SOC unit is the base unit of the topological structure used to develop the four basic equations of the mechanism topology.
- Chapters 2, 4, 6: B The mechanism composition principle based on the SOC units. This book proposes a mechanism composition principle based on the SOC units to establish a systematic theory for the unified modeling of the topology, kinematics, and dynamics of mechanisms based on the SOC units.
- Chapter 7: C Four basic equations: The POC equation of serial mechanisms with 10 symbolic operation rules (Chapter 4); The POC equation of parallel mechanisms with 14 symbolic operation rules (Chapter 5); The general DOF formula for spatial mechanisms (Chapter 6); The coupling degree formula for the Assur kinematic chain (Chapter 7).
- D One systematic method for the topology design of robot mechanisms (Chapters 8, 10). Based on the three basic concepts and the four basic equations addressed above, this book puts forward a systematic method for the topology design of parallel mechanisms, which is fundamentally different from all existing methods. Its main characteristics are as follows: The design process includes two stages: the first is structure synthesis, which derives many structure types; the second involves the performance analysis, classification, and optimization of structure types derived from the first stage. The design operation is independent of the motion positions and the fixed coordinate system. Therefore, the proposed method is essentially a geometrical method, which ensures the full cycle DOF and the generality of geometric conditions of mechanism existence. Each individual design step follows an explicit formula or the guidelines for design criteria, making the operation simple, feasible, and reproducible. In addition, the topology design of the SCARA PMs is studied in detail to demonstrate the proposed method (Chapter 10).

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