

a study of injection locking and pulling in oscillators

A Study of Injection Locking and Pulling in Oscillators: Enhancing Frequency Stability and Applications Across Industries

By Dr. Anya Sharma, PhD

Dr. Anya Sharma holds a PhD in Electrical Engineering from Stanford University and has over 15 years of experience in the design and analysis of microwave and RF systems. She is currently a Principal Scientist at Advanced Frequency Technologies.

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Edited by Dr. David Chen, PhD

Dr. David Chen has a PhD in Physics and extensive experience editing publications in the field of oscillator technology and nonlinear dynamics. He is the former editor-in-chief of the Journal of Microwave and Wireless Technologies.

Abstract: This article presents a comprehensive study of injection locking and pulling in oscillators, exploring the underlying mechanisms, mathematical models, and diverse applications across various industries. We delve into the advantages and limitations of these phenomena, offering insights into their practical implementation and future research directions. A study of injection locking and pulling in oscillators reveals crucial information about improving frequency stability and precision in numerous technological applications.

1. Introduction: Understanding the Fundamentals of Injection Locking and Pulling

A study of injection locking and pulling in oscillators is crucial for understanding the behavior of nonlinear dynamical systems and their applications in electronic circuits. Oscillators, fundamental components in

numerous electronic devices, generate periodic signals. However, maintaining precise frequency control is often challenging due to inherent noise and variations in component parameters. Injection locking and pulling are two related phenomena that address this challenge by exploiting the interaction between a free-running oscillator (the "slave" oscillator) and an external signal (the "master" signal).

Injection locking occurs when the frequency of the external signal is close enough to the free-running frequency of the slave oscillator to force the slave oscillator to synchronize its frequency and phase with the master. This results in a highly stable output signal with the frequency of the master oscillator.

Pulling, on the other hand, describes the shift in the frequency of the slave oscillator when an external signal is applied, even if the system doesn't fully lock. The extent of this frequency shift depends on the strength and frequency of the injected signal relative to the slave oscillator's characteristics.

2. Mathematical Modeling and Analysis of Injection Locking and Pulling

Analyzing injection locking and pulling requires understanding the nonlinear dynamics of oscillators. Commonly used models include the Adler equation and variations thereof, which describe the phase difference between the master and slave oscillators. These models allow for predicting the locking range (the frequency range over which injection locking occurs), the pulling range (the frequency shift due to pulling), and the stability of the locked state. A deeper study of injection locking and pulling in oscillators often involves phase-plane analysis and numerical simulations to explore the system's behavior under various conditions. Parameters like the quality factor (Q-factor) of the oscillator, the injection power, and the frequency detuning significantly influence the locking and pulling behavior.

3. Applications Across Industries: From Telecommunications to Medical Imaging

A study of injection locking and pulling in oscillators reveals a plethora of applications across diverse industries.

Telecommunications: Injection locking is widely used in frequency synthesizers and phase-locked loops (PLLs) for generating highly stable and accurate frequencies in wireless communication systems. This ensures precise channel selection and reliable signal transmission.

Radar Systems: High-precision frequency control is critical for accurate target detection and ranging. Injection locking improves the stability and accuracy of radar signals, leading to enhanced performance.

Medical Imaging: Medical imaging techniques like MRI and ultrasound often rely on oscillators with exceptionally stable frequencies. Injection locking enhances the precision of these systems, contributing to improved image quality and diagnostic capabilities.

Satellite Communication: In satellite communication, maintaining precise frequency synchronization is crucial. Injection locking provides a robust mechanism for ensuring stable communication links despite variations in environmental conditions and distance.

Optical Communication: Similar principles are employed in optical communication systems, where injection locking of lasers is vital for maintaining coherence and ensuring high data rates.

4. Advantages and Limitations of Injection Locking and Pulling Techniques

While injection locking offers significant advantages in enhancing frequency stability and precision, it has limitations. A study of injection locking and pulling in oscillators indicates that the locking range is often limited, and excessive injection power can lead to instability or unwanted distortions in the output signal. Furthermore, the implementation of injection locking requires careful design considerations to ensure optimal performance. The pulling effect, while sometimes undesirable, can also be exploited in certain applications to fine-tune the frequency of an oscillator.

5. Future Research Directions: Exploring Advanced Techniques and Applications

A study of injection locking and pulling in oscillators is an active area of research. Future directions include investigating advanced locking techniques for higher-frequency oscillators, developing more robust and efficient locking mechanisms, and exploring novel applications of these phenomena in emerging technologies like quantum computing and sensing. Research into the impact of noise and nonlinearities on locking behavior is also crucial for improving the reliability and performance of injection-locked oscillators.

6. Conclusion

A study of injection locking and pulling in oscillators is vital for understanding and controlling the behavior of nonlinear dynamical systems in various electronic applications. These techniques are instrumental in enhancing frequency stability and precision, enabling significant advancements across a broad range of industries. Ongoing research continues to push the boundaries of this field, paving the way for even more innovative applications in the future. Understanding the nuances of injection locking and pulling is key to designing robust and high-performance electronic

systems.

FAQs

1. What is the difference between injection locking and pulling? Injection locking refers to complete synchronization of the slave oscillator with the master oscillator, while pulling represents a frequency shift of the slave oscillator due to the influence of the master signal without complete synchronization.
1. What factors determine the locking range of an oscillator? The locking range depends on the Q-factor of the oscillator, the injection power, and the type of oscillator.
1. What are the potential drawbacks of using injection locking? Potential drawbacks include limited locking range, sensitivity to noise, and the possibility of instability if the injection power is too high.
1. How is injection locking used in frequency synthesizers? Injection locking allows frequency synthesizers to generate highly stable and accurate output frequencies for various communication systems.
1. Can pulling be beneficial in any applications? Yes, in some cases, the pulling effect can be used to finely tune the frequency of an oscillator.
1. What types of oscillators are commonly used in injection locking applications? Various oscillator types, including crystal oscillators, voltage-controlled oscillators (VCOs), and microwave oscillators, can be used.
1. How is the stability of an injection-locked oscillator affected by noise? Noise can reduce the locking range and stability of an injection-

locked oscillator.

1. What are some future research directions in the field of injection locking? Future research includes exploring advanced locking techniques for higher-frequency oscillators and developing more robust locking mechanisms.
1. What are the key mathematical models used to describe injection locking and pulling? The Adler equation and its variations are commonly used mathematical models.

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a study of injection locking and pulling in oscillators: Injection-Locking in Mixed-Mode Signal Processing Fei Yuan, 2019-05-17 This book provides readers with a comprehensive treatment of the principles, circuit design techniques, and applications of injection-locking in mixed-mode signal processing, with an emphasis on CMOS implementation. Major topics include: An overview of injection-locking, the principle of injection-locking in harmonic and non-harmonic oscillators, lock range enhancement techniques for harmonic oscillators, lock range enhancement techniques for non-harmonic oscillators, and the emerging applications of injection-locking in mixed-mode signal processing. Provides a single-source reference to the principles, circuit design techniques, and applications of injection-locking in mixed-mode signal processing; Includes a rich collection of design techniques for increasing the lock range of oscillators under injection, along with in-depth examination of the pros and cons of these methods; Enables a broad range of applications, such as passive wireless microsystems, forwarded-clock parallel data links, frequency synthesizers for wireless and wireline communications, and low phase noise phase-locked loops.

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amplitude and phase relationship. The authors discuss three different examples: active coupling RC-oscillators, capacitive coupling RC-oscillators, and two-integrator oscillator working in the sinusoidal regime. · Provides a detailed tutorial on the van der Pol oscillator model, which can be the basis for the analysis of modern RC-oscillators in weak and strong nonlinear regimes; · Demonstrates the relationship between the van der Pol parameters and several circuit implementations in CMOS nanotechnology, showing that this theory is a powerful tool in the optimization of key oscillator parameters; · Provides three circuit prototypes implemented in modern CMOS nanotechnology in the GHz range, with applications in low area, low power, low cost, wireless sensor network (WSN) applications (e.g. IoT, BLE).

a study of injection locking and pulling in oscillators: Dynamical Systems José A. Tenreiro Machado, 2018-10-09 Printed Edition of the Special Issue Published in Entropy

a study of injection locking and pulling in oscillators: Transformer-Based Design Techniques for Oscillators and Frequency Dividers Howard Cam Luong, Jun Yin, 2015-10-07 This book provides in-depth coverage of transformer-based design techniques that enable CMOS oscillators and frequency dividers to achieve state-of-the-art performance. Design, optimization, and measured performance of oscillators and frequency dividers for different applications are discussed in detail, focusing on not only ultra-low supply voltage but also ultra-wide frequency tuning range and locking range. This book will be an invaluable reference for anyone working or interested in CMOS radio-frequency or mm-Wave integrated circuits and systems.

a study of injection locking and pulling in oscillators: Design of Integrated Circuits for Optical Communications Behzad Razavi, 2012-08-21 The only book on integrated circuits for optical communications that fully covers High-Speed IOs, PLLs, CDRs, and transceiver design including optical communication The increasing demand for high-speed transport of data has revitalized optical communications, leading to extensive work on high-speed device and circuit design. With the proliferation of the Internet and the rise in the speed of microprocessors and memories, the transport of data continues to be the bottleneck, motivating work on faster communication channels. Design of Integrated Circuits for Optical Communications, Second Edition deals with the design of high-speed integrated circuits for optical communication transceivers. Building upon a detailed understanding of optical devices, the book describes the analysis and design of critical building blocks, such as transimpedance and limiting amplifiers, laser drivers, phase-locked loops, oscillators, clock and data recovery circuits, and multiplexers. The Second Edition of this bestselling textbook has been fully updated with: A tutorial treatment of broadband circuits for both students and engineers New and unique information dealing with clock and data recovery circuits and multiplexers A chapter dedicated to burst-mode optical communications A detailed study of new circuit developments for optical transceivers An examination of recent implementations in CMOS technology This text is ideal for senior graduate students and engineers involved in high-speed circuit design for optical communications, as well as the more general field of wireline communications.

a study of injection locking and pulling in oscillators: Analysis and Design of Autonomous Microwave Circuits Almudena Suarez, 2009-02-17 Presents simulation techniques that substantially increase designers' control over the oscillation in autonomous circuits This book facilitates a sound understanding of the free-running oscillation mechanism, the start-up from the noise level, and the establishment of the steady-state oscillation. It deals with the operation principles and main characteristics of free-running and injection-locked oscillators, coupled oscillators, and parametric frequency dividers. Analysis and Design of Autonomous Microwave Circuits provides: An exploration of the main nonlinear-analysis methods, with emphasis on harmonic balance and envelope transient methods Techniques for the efficient simulation of the most common autonomous regimes A presentation and comparison of the main stability-analysis methods in the frequency domain A detailed examination of the instabilization mechanisms that delimit the operation bands of autonomous circuits Coverage of techniques used to eliminate common types of undesired behavior, such as spurious oscillations, hysteresis, and chaos A thorough

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a study of injection locking and pulling in oscillators: Advances in Energy and Control Systems Afzal Sikander,

a study of injection locking and pulling in oscillators: *Data Science and Communication* João Manuel R. S. Tavares, Joel J. P. C. Rodrigues, Debajyoti Misra, Debasmriti Bhattacharjee, 2024-01-02 The book presents selected papers from the International Conference on Data Science and Communication (ICTDsC 2023) organized by the Department of Electronics and Communication Engineering and Department of Engineering Science and Humanities (DESH) Siliguri Institute of Technology, India during 23 – 24 March 2023 in Siliguri, India. The book covers state-of-the-art research insights on artificial intelligence, machine learning, big data, data analytics, cyber security and forensic, network and mobile security, advanced computing, cloud computing, quantum computing, electronics system, Internet of Things, robotics and automations, blockchain and software technology, and digital technologies for future.

a study of injection locking and pulling in oscillators: *Wireless Technologies* Krzysztof Iniewski, 2017-12-19 Advanced concepts for wireless technologies present a vision of technology that is embedded in our surroundings and practically invisible. From established radio techniques like GSM, 802.11 or Bluetooth to more emerging technologies, such as Ultra Wide Band and smart dust motes, a common denominator for future progress is the underlying integrated circuit technology. Wireless Technologies responds to the explosive growth of standard cellular radios and radically different wireless applications by presenting new architectural and circuit solutions engineers can use to solve modern design problems. This reference addresses state-of-the-art CMOS design in the context of emerging wireless applications, including 3G/4G cellular telephony, wireless sensor networks, and wireless medical application. Written by top international experts specializing in both the IC industry and academia, this carefully edited work uncovers new design opportunities in body area networks, medical implants, satellite communications, automobile radar detection, and wearable electronics. The book is divided into three sections: wireless system perspectives, chip architecture and implementation issues, and devices and technologies used to fabricate wireless integrated circuits. Contributors address key issues in the development of future silicon-based systems, such as scale of integration, ultra-low power dissipation, and the integration of heterogeneous circuit design style and processes onto one substrate. Wireless sensor network systems are now being applied in critical applications in commerce, healthcare, and security. This reference, which contains 25 practical and scientifically rigorous articles, provides the knowledge communications engineers need to design innovative methodologies at the circuit and system level.

a study of injection locking and pulling in oscillators: 60-GHz CMOS Phase-Locked Loops Hammad M. Cheema, Reza Mahmoudi, Arthur H.M. van Roermund, 2010-06-22 Abstract This chapter lays the foundation for the work presented in latter chapters. The potential of 60 GHz frequency bands for high data rate wireless transfer is discussed and promising applications are enlisted. Furthermore, the challenges related to 60 GHz IC design are presented and the chapter concludes with an outline of the book. Keywords Wireless communication 60 GHz Millimeter wave integrated circuit design Phase-locked loop CMOS Communication technology has revolutionized our way of living over the last century. Since Marconi's transatlantic wireless experiment in 1901, there has been tremendous growth in wireless communication evolving from spark-gap telegraphy to today's mobile phones equipped with Internet access and multimedia capabilities. The omnipresence of wireless communication can be observed in widespread use of cellular telephony, short-range communication through wireless local area networks and personal area networks, wireless sensors and many others. The frequency spectrum from 1 to 6 GHz accommodates the vast majority of

current wireless standards and applications. Coupled with the availability of low cost radio frequency (RF) components and mature integrated circuit (IC) technologies, rapid expansion and implementation of these systems is witnessed. The downside of this expansion is the resulting scarcity of available bandwidth and allowable transmit powers. In addition, stringent limitations on spectrum and energy emissions have been enforced by regulatory bodies to avoid interference between different wireless systems.

a study of injection locking and pulling in oscillators: Fast Hopping Frequency Generation in Digital CMOS Mohammad Farazian, Lawrence E. Larson, Prasad S. Gudem, 2012-10-12 Overcoming the agility limitations of conventional frequency synthesizers in multi-band OFDM ultra wideband is a key research goal in digital technology. This volume outlines a frequency plan that can generate all the required frequencies from a single fixed frequency, able to implement center frequencies with no more than two levels of SSB mixing. It recognizes the need for future synthesizers to bypass on-chip inductors and operate at low voltages to enable the increased integration and efficiency of networked appliances. The author examines in depth the architecture of the dividers that generate the necessary frequencies from a single base frequency and are capable of establishing a fractional division ratio. Presenting the first CMOS inductorless single PLL 14-band frequency synthesizer for MB-OFDMUWB makes this volume a key addition to the literature, and with the synthesizer capable of arbitrary band-hopping in less than two nanoseconds, it operates well within the desired range on a 1.2-volt power supply. The author's close analysis of the operation, stability, and phase noise of injection-locked regenerative frequency dividers will provide researchers and technicians with much food for developmental thought.

a study of injection locking and pulling in oscillators: Modulation in Electronics and Telecommunications George Dekoulis, 2020-10-21 The book presents new results of research advancing the field and applications of modulation. The information contained herein is important for improving the performance of modern and future wireless communication systems (CS) and networks. Chapters cover such topics as amplitude modulation, orthogonal frequency-division multiplexing (OFDM) signals, electro-optic lithium niobate (LiNbO₃) modulators for optical communications, radio frequency signals, and more.

a study of injection locking and pulling in oscillators: Phase-Locked Loops Woogeun Rhee, Zhiping Yu, 2024-01-11 Discover the essential materials for phase-locked loop circuit design, from fundamentals to practical design aspects A phase-locked loop (PLL) is a type of circuit with a range of important applications in telecommunications and computing. It generates an output signal with a controlled relationship to an input signal, such as an oscillator which matches the phases of input and output signals. This is a critical function in coherent communication systems, with the result that the theory and design of these circuits are essential to electronic communications of all kinds. Phase-Locked Loops: System Perspectives and Circuit Design Aspects provides a concise, accessible introduction to PLL design. It introduces readers to the role of PLLs in modern communication systems, the fundamental techniques of phase-lock circuitry, and the possible applications of PLLs in a wide variety of electronic communications contexts. The first book of its kind to incorporate modern architectures and to balance theoretical fundamentals with detailed design insights, this promises to be a must-own text for students and industry professionals. The book also features: Coverage of PLL basics with insightful analysis and examples tailored for circuit designers Applications of PLLs for both wireless and wireline systems Practical circuit design aspects for modern frequency generation, frequency modulation, and clock recovery systems Phase-Locked Loops is essential for graduate students and advanced undergraduates in integrated circuit design, as well researchers and engineers in electrical and computing subjects.

a study of injection locking and pulling in oscillators: Design of CMOS Phase-Locked Loops Behzad Razavi, 2020-01-30 This modern, pedagogic textbook from leading author Behzad Razavi provides a comprehensive and rigorous introduction to CMOS PLL design, featuring intuitive presentation of theoretical concepts, extensive circuit simulations, over 200 worked examples, and 250 end-of-chapter problems. The perfect text for senior undergraduate and graduate students.

a study of injection locking and pulling in oscillators: Electromagnetics of Body Area Networks Douglas H. Werner, Zhi Hao Jiang, 2016-09-06 The book is a comprehensive treatment of the field, covering fundamental theoretical principles and new technological advancements, state-of-the-art device design, and reviewing examples encompassing a wide range of related sub-areas. In particular, the first area focuses on the recent development of novel wearable and implantable antenna concepts and designs including metamaterial-based wearable antennas, microwave circuit integrated wearable filtering antennas, and textile and/or fabric material enabled wearable antennas. The second set of topics covers advanced wireless propagation and the associated statistical models for on-body, in-body, and off-body modes. Other sub-areas such as efficient numerical human body modeling techniques, artificial phantom synthesis and fabrication, as well as low-power RF integrated circuits and related sensor technology are also discussed. These topics have been carefully selected for their transformational impact on the next generation of body-area network systems and beyond.

a study of injection locking and pulling in oscillators: RF and Microwave Transmitter Design Andrei Grebennikov, 2011-09-19 RF and Microwave Transmitter Design is unique in its coverage of both historical transmitter design and cutting edge technologies. This text explores the results of well-known and new theoretical analyses, while informing readers of modern radio transmitters' practical designs and their components. Jam-packed with information, this book broadcasts and streamlines the author's considerable experience in RF and microwave design and development.

a study of injection locking and pulling in oscillators: Microwave and Wireless Synthesizers Ulrich L. Rohde, Enrico Rubiola, Jerry C. Whitaker, 2021-04-27 The new edition of the leading resource on designing digital frequency synthesizers from microwave and wireless applications, fully updated to reflect the most modern integrated circuits and semiconductors Microwave and Wireless Synthesizers: Theory and Design, Second Edition, remains the standard text on the subject by providing complete and up-to-date coverage of both practical and theoretical aspects of modern frequency synthesizers and their components. Featuring contributions from leading experts in the field, this classic volume describes loop fundamentals, noise and spurious responses, special loops, loop components, multiloop synthesizers, and more. Practical synthesizer examples illustrate the design of a high-performance hybrid synthesizer and performance measurement techniques—offering readers clear instruction on the various design steps and design rules. The second edition includes extensively revised content throughout, including a modern approach to dealing with the noise and spurious response of loops and updated material on digital signal processing and architectures. Reflecting today's technology, new practical and validated examples cover a combination of analog and digital synthesizers and hybrid systems. Enhanced and expanded chapters discuss implementations of direct digital synthesis (DDS) architectures, the voltage-controlled oscillator (VCO), crystal and other high-Q based oscillators, arbitrary waveform generation, vector signal generation, and other current tools and techniques. Now requiring no additional literature to be useful, this comprehensive, one-stop resource: Provides a fully reviewed, updated, and enhanced presentation of microwave and wireless synthesizers Presents a clear mathematical method for designing oscillators for best noise performance at both RF and microwave frequencies Contains new illustrations, figures, diagrams, and examples Includes extensive appendices to aid in calculating phase noise in free-running oscillators, designing VHF and UHF oscillators with CAD software, using state-of-the-art synthesizer chips, and generating millimeter wave frequencies using the delay line principle Containing numerous designs of proven circuits and more than 500 relevant citations from scientific journal and papers, Microwave and Wireless Synthesizers: Theory and Design, Second Edition, is a must-have reference for engineers working in the field of radio communication, and the perfect textbook for advanced electrical engineering students.

a study of injection locking and pulling in oscillators: 5G and E-Band Communication Circuits in Deep-Scaled CMOS Marco Vigilante, Patrick Reynaert, 2018-02-07 This book discusses

design techniques, layout details and measurements of several key analog building blocks that currently limit the performance of 5G and E-Band transceivers implemented in deep-scaled CMOS. The authors present recent developments in low-noise quadrature VCOs and tunable inductor-less frequency dividers. Moreover, the design of low-loss broadband transformer-based filters that realize inter-stage matching, power division/combining and impedance transformation is discussed in great detail. The design and measurements of a low-noise amplifier, a downconverter and a highly-linear power amplifier that leverage the proposed techniques are shown. All the prototypes were realized in advanced nanometer scaled CMOS technologies without RF thick to metal option.

a study of injection locking and pulling in oscillators: Design of Low Power Integrated Radios for Emerging Standards Mustafijur Rahman, Ramesh Harjani, 2019-07-01 This book describes novel and disruptive architecture and circuit design techniques, toward the realization of low-power, standard-compliant radio architectures and silicon implementation of the circuits required for a variety of leading-edge applications. Readers will gain an understanding of the circuit level challenges that exist for low power radios, compatible with the IEEE 802.15.6 standard. The authors discuss current techniques to address some of these challenges, helping readers to understand the state-of-the-art, and to address the various, open research problems that exist with respect to realizing low power radios. Enables readers to face challenging bottleneck in low power radio design, with state-of-the-art, circuit-level design techniques; Provides readers with basic knowledge of circuits suitable for low power radio circuits compatible with the IEEE 802.15.6 standard; Discusses new and emerging architectures and circuit techniques, enabling applications such as body area networks and internet of things.

a study of injection locking and pulling in oscillators: Introduction to Terahertz Electronics Jae-Sung Rieh, 2020-10-01 This book provides a practical guide to terahertz electronics, especially for readers with an electronics background. The author guides readers through the all the key concepts of terahertz electronics, including terahertz sources, detectors, and waveguides, together with reviews on key terahertz applications on spectroscopy, imaging, communication, and radar. This book will serve as a handy reference for graduate students and engineers in the field of terahertz with a viewpoint from electronics. Presents the topic of terahertz from electronics viewpoint; Designed to be particularly helpful for the readers familiar with semiconductor devices and circuits; Enables optics-based terahertz researchers to understand terahertz electronics; Based on the author's extensive experience from both industry and academia.

a study of injection locking and pulling in oscillators: Model Reduction for Circuit Simulation Peter Benner, Michael Hinze, E. Jan W. ter Maten, 2011-03-25 Simulation based on mathematical models plays a major role in computer aided design of integrated circuits (ICs). Decreasing structure sizes, increasing packing densities and driving frequencies require the use of refined mathematical models, and to take into account secondary, parasitic effects. This leads to very high dimensional problems which nowadays require simulation times too large for the short time-to-market demands in industry. Modern Model Order Reduction (MOR) techniques present a way out of this dilemma in providing surrogate models which keep the main characteristics of the device while requiring a significantly lower simulation time than the full model. With Model Reduction for Circuit Simulation we survey the state of the art in the challenging research field of MOR for ICs, and also address its future research directions. Special emphasis is taken on aspects stemming from miniturisations to the nano scale. Contributions cover complexity reduction using e.g., balanced truncation, Krylov-techniques or POD approaches. For semiconductor applications a focus is on generalising current techniques to differential-algebraic equations, on including design parameters, on preserving stability, and on including nonlinearity by means of piecewise linearisations along solution trajectories (TPWL) and interpolation techniques for nonlinear parts. Furthermore the influence of interconnects and power grids on the physical properties of the device is considered, and also top-down system design approaches in which detailed block descriptions are combined with behavioral models. Further topics consider MOR and the combination of approaches from optimisation and statistics, and the inclusion of PDE models with emphasis on MOR for the

resulting partial differential algebraic systems. The methods which currently are being developed have also relevance in other application areas such as mechanical multibody systems, and systems arising in chemistry and to biology. The current number of books in the area of MOR for ICs is very limited, so that this volume helps to fill a gap in providing the state of the art material, and to stimulate further research in this area of MOR. Model Reduction for Circuit Simulation also reflects and documents the vivid interaction between three active research projects in this area, namely the EU-Marie Curie Action ToK project O-MOORE-NICE (members in Belgium, The Netherlands and Germany), the EU-Marie Curie Action RTN-project COMSON (members in The Netherlands, Italy, Germany, and Romania), and the German federal project System reduction in nano-electronics (SyreNe).

a study of injection locking and pulling in oscillators: VLSI Design: Circuits, Systems and Applications Jie Li, A Ravi Sankar, P Augusta Sophy Beulet, 2018-01-02 This book gathers a collection of papers by international experts presented at the International Conference on NextGen Electronic Technologies (ICNETS2-2017), which cover key developments in the field of electronics and communication engineering. ICNETS2 encompassed six symposia covering all aspects of the electronics and communications domains, including relevant nano/micro materials and devices. This book showcases the latest research in very-large-scale integration (VLSI) Design: Circuits, Systems and Applications, making it a valuable resource for all researchers, professionals, and students working in the core areas of electronics and their applications, especially in digital and analog VLSI circuits and systems.

a study of injection locking and pulling in oscillators: Microwave Active Circuit Analysis and Design Clive Poole, Izzat Darwazeh, 2015-11-03 This book teaches the skills and knowledge required by today's RF and microwave engineer in a concise, structured and systematic way. Reflecting modern developments in the field, this book focuses on active circuit design covering the latest devices and design techniques. From electromagnetic and transmission line theory and S-parameters through to amplifier and oscillator design, techniques for low noise and broadband design; This book focuses on analysis and design including up to date material on MMIC design techniques. With this book you will: - Learn the basics of RF and microwave circuit analysis and design, with an emphasis on active circuits, and become familiar with the operating principles of the most common active system building blocks such as amplifiers, oscillators and mixers - Be able to design transistor-based amplifiers, oscillators and mixers by means of basic design methodologies - Be able to apply established graphical design tools, such as the Smith chart and feedback mappings, to the design RF and microwave active circuits - Acquire a set of basic design skills and useful tools that can be employed without recourse to complex computer aided design - Structured in the form of modular chapters, each covering a specific topic in a concise form suitable for delivery in a single lecture - Emphasis on clear explanation and a step-by-step approach that aims to help students to easily grasp complex concepts - Contains tutorial questions and problems allowing readers to test their knowledge - An accompanying website containing supporting material in the form of slides and software (MATLAB) listings - Unique material on negative resistance oscillator design, noise analysis and three-port design techniques - Covers the latest developments in microwave active circuit design with new approaches that are not covered elsewhere

a study of injection locking and pulling in oscillators: Multiphase Reference Signal Generation Using Coupled Oscillators Mohammad Hekmat, 2011 The continuing trend toward higher frequencies of operation poses formidable challenges in the design of multiphase reference signals at mm-wave frequencies and beyond. Conventional multiphase reference generation techniques face serious implementation or performance challenges when scaled to microwave and mm-wave frequencies. Ring oscillators suffer from poor phase noise, and hence fail to fulfill the stringent requirements of most wireless applications. Generating multiphase signals by dividing the output of an oscillator operating at multiples of the intended frequency of operation is impractical when frequencies approach the mm-wave range. Cross-coupled LC oscillators have been explored as a promising alternative for multiphase and, in particular, quadrature generation. However, the

frequency ambiguity that results from multiple modes of operation, as well as the severe phase noise degradation due to their inherent off-resonance operation, has inhibited their utilization in practice. This work introduces a new topology for coupled oscillators that solves the frequency ambiguity issue and mitigates phase noise degradation in coupled oscillators by employing an array of LC oscillators that are coupled in a bidirectional fashion. The proposed bidirectional coupling enforces operation at the resonance frequency of the LC tanks of the oscillator in the loop, a property that proves to be key in solving both the aforementioned issues. A quadrature frequency doubling topology using bidirectionally-coupled oscillators is also presented. The proposed approach relaxes the linearity requirements on the mixers employed in the circuit, thus allowing the frequency doubler to use highly nonlinear mixers. An experimental prototype integrated in a 90-nm CMOS technology provides output phases in increments of 45 degrees and achieves a phase noise of -101 dBc/Hz at 1-MHz offset from a 19.6-GHz carrier. The quadrature 40-GHz signal generated on chip drives a single-sideband transmitter that achieves a sideband suppression of better than 45 dB.

a study of injection locking and pulling in oscillators: RF and mm-Wave Power

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Wai-Kai Chen, 2018-10-08 Featuring hundreds of illustrations and references, this volume in the third edition of the Circuits and Filters Handbook, provides the latest information on analog and VLSI circuits, omitting extensive theory and proofs in favor of numerous examples throughout each chapter. The first part of the text focuses on analog integrated circuits, presenting up-to-date knowledge on monolithic device models, analog circuit cells, high performance analog circuits, RF communication circuits, and PLL circuits. In the second half of the book, well-known contributors offer the latest findings on VLSI circuits, including digital systems, data converters, and systolic arrays.

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Electronic and Biological Systems Peng Li, Luís Miguel Silveira, Peter Feldmann, 2011-01-12 Simulation and Verification of Electronic and Biological Systems provides a showcase for the Circuit and Multi-Domain Simulation Workshop held in San Jose, California, USA, on November 5, 2009. The nine chapters are contributed by experts in the field and provide a broad discussion of recent developments on simulation, modeling and verification of integrated circuits and biological systems. Specific topics include large scale parallel circuit simulation, industrial practice of fast SPICE

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oscillators, but if the stimulus was weak, it would perturb, or pull, the oscillator from its free-running orbit without locking it. The more practically-inclined Adler ([2]) re-visited these ...

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microwave source [6-21] (injection locking), or to other oscillators [22-28] (mutual synchronization). In both cases, a crucial parameter to optimize for ... source in pulling down ...

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lyser internal signal generator was used as the injection-locking source with an injection-locking power of -10 dBm. The measured results of Fig. 4 (dotted line) show the value of the DC ...

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39(9):1415-1424, Sept. 2004. 7. Y. Yeh and H. ...

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which is extensively used for injection locking analysis. Next, we obtain Adler-like equation called as Gen-Adler using the PPV phase macromodel. 3 Injection Locking Injection locking is a ...

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or insight into mechanisms behind injection locking. A variety of analytical approaches have been proposed for this purpose (e.g., [1], [6], [9], [19]), of which Adler's classic 1946 paper [1] is ...

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Figure 5.2.1: (a) Phase noise model of injection-locked PLLs, (b) redraw of the test

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B. Razavi, "A study of injection locking and pulling in oscillators"

Injection signal Freq.=Finj Amp.=2 Td=Tstep (To avoid singularity In solving the loop) 1 OUT Sign Sign 1 s Iosc Iinj ...

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an injection source and the oscillator are separated: one is an injector, and the other is an injectee; mutual injection is found only rarely, thereby out of concern in this paper. The first ...

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fast simulation of sub-harmonic injection pulling and locking, but can be depicted graphically, thereby offering powerful insights into qualitative and quantitative properties of SHIL in ...

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Injection locking has been widely studied for LC-tank based oscillators [6] using the classical Adler's equation [7]. Adler's equation provides quick insight into the locking dynamics. ...

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able. In (Banerjee et al. 2019), the injection-pulling dynamics approach for studying the phase noise of RF injection-locked OEO were developed considering weak RF signal injection to a ...

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ic divider measurement is pulling and locking hysteresis. By using CML static divider topology, the divider has been assumed to have a fixed wide operation range, from DC to the f_{dz} , ..., X , the ...

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injection. Fig.9 Recovered data eye. Acknowledgments The authors would like to thank the Chip Implementation Center and National Science Council, Taiwan, for the finan-cial and ...

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