National Security Engineering Research
Engineering various security systems are of the utmost importance to our State of Nevada as well as the nation.

UNLV researchers have been addressing many challenges related to security engineering. This research has addressed questions related to many fields, including blast containment, shock mitigation, and smart grid security. Our researchers have been funded by various federal and state agencies as well as industrial partners.

We would like to introduce you to some of our researchers. Please feel to contact us if we can help with future collaboration.

Dr. Rama Venkat  
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Dr. Mohamed Trabia  
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Graphics on Slide 1: Computational fluid dynamics visualization of truck body aerodynamic drag reduction technology (Dr. William Culbreth).
National Security Engineering Research
Areas of Expertise

- Computational modeling of radiation transport and nuclear criticality problems
- Nuclear systems design and analysis
- Nuclear applications of accelerators
- Radiation detectors
- Active neutron interrogation and detection of special nuclear material
- Nuclear non-proliferation
- Nano-material-enhanced radiation shielding
- Development of detection algorithms and adaptive signal processing
- High-speed, high-frequency microelectronics
- GaN semiconductors and devices
- Radiation-hard electronics, optoelectronics, and imaging systems
- Ultrafast lasers and electronics
- High Energy Density Physics (HEDP) diagnostics
- Synthesis and characterization of advanced nuclear fuels and materials.
- Synthesis and properties of novel ceramic waste forms to immobilize radioactive high-level waste.
- Crystal structure characterization by X-ray fine structure analysis and Rietveld structure refinement.
- Determination of phase transitions by high-temperature X-ray diffraction.
- High resolution electron microscopy using an analytical FE-TEM on irradiated and radioactive metals and ceramics.
- Novel accelerator-based method to determine radiolytic product formation within the near-field of a generic geological repository.
National Security Engineering
Research Areas of Expertise

• Sensor technologies and instrumentation for safety monitoring and process control
• Transportation security imaging and secure communication software development
• Biometrics
• Image analysis
• Pulsed-ray radioscopy to detect nuclear materials
• Pulsed power and plasma physics
• Radioscopic cargo screening using mega-voltage energy
• Novel radiation detector development for UAVs
• Secure, reliable communication protocols for UAVs
• Design of highly competitive online algorithms against different adversaries
• Critical infrastructure / Smart Grid security
• Man-In-The-Middle (MITM) attack with tempered SSL certificate detection
• Thwarting Distributed Denial of Service (DDoS) attacks

• Digital search warrants
• Secure protocol development for software and network applications
• Wireless mesh network routing and security
• Airport security inspection software design and DICOS standard development
• Insider threat detection
• Structural analysis, failure analysis, experimental mechanics
• Structural dynamics, explosives, and impact analysis
• Computational simulation of highly dynamic events
• Material characterization, custom component testing
• Progressive collapse resistance of structures
• Simulation of structures subjected to normal and extreme loading events
• Earthquake engineering
National Security Engineering Research

Why UNLV?

• Las Vegas is a dynamic city with a population that includes multiple ethnicities and age groups.
• UNLV has a strong team of researchers who have collaborated on various areas of security engineering studies.
• UNLV researchers also have developed strong collaboration with key industrial partners including:
  • National Security Technologies, LLC (NSTec)
    - NSTec manages operations at the Nevada National Security Site (NNSS) -- formerly known as the Nevada Test Site -- and its related facilities and laboratories for the Department of Energy's National Nuclear Security Administration.
  • Varian Medical Systems
    - Varian's Security and Inspection Products group, based in Las Vegas, provides cargo screening systems with linear accelerators for X-ray imaging for cargo screening operations.
• UNLV is in the process of acquiring a linear accelerator, K9, which can be used for various applications, including cargo imaging for Homeland Security and U.S. Customs; we are also involved in radio-pharmaceutical production and medium-to-high dose rate research.
Faculty Involved in National Security Engineering Research

- **Dr. Alexander Barzilov**  
  Associate Professor, Department of Mechanical Engineering

- **Dr. Wolfgang Bein**  
  Professor, Department of Computer Science  
  Co-Director, Center for Information Technology and Algorithms (CITA)

- **Dr. Thomas Hartmann**  
  Assistant Professor, Department of Mechanical Engineering

- **Dr. William Culbreth**  
  Associate Professor, Department of Mechanical Engineering

- **Dr. Yingtao Jiang**  
  Associate Professor, Department of Electrical and Computer Engineering

- **Dr. Juyeon Jo**  
  Associate Professor, Department of Computer Science

- **Dr. Kwang J. Kim**  
  Southwest Gas Professor of Energy and Matter  
  Department of Mechanical Engineering

- **Dr. Yooghan Kim, CISSP**  
  Associate Professor, Department of Computer Science

- **Dr. Shahram Latifi, P.E.**  
  Professor, Department of Electrical and Computer Engineering  
  Co-Director, Center for Information Technology and Algorithms (CITA)
Faculty Involved in National Security Engineering Research

- **Dr. Brendan J. O'Toole**  
  *Professor, Department of Mechanical Engineering*  
  *Director, Mendenhall Innovation Program*

- **Dr. Emma Regentova**  
  *Professor, Department of Electrical and Computer Engineering*

- **Dr. Stephen Rice, CPHIT, P.E.**  
  *Professor, Department of Mechanical Engineering*

- **Dr. Aly Said, P.E.**  
  *Assistant Professor, Department of Civil and Environmental Engineering and Construction*

- **Dr. Robert Schill**  
  *Professor, Department of Electrical and Computer Engineering*  
  *Director, Energy Materials Interaction Technology Initiative of Nevada (EMITION) Center*

- **Dr. Ke-Xun (Kevin) Sun**  
  *Professor, Department of Electrical and Computer Engineering*

- **Dr. Ying Tian, P.E.**  
  *Assistant Professor, Department of Civil and Environmental Engineering and Construction*

- **Dr. Mohamed Trabia**  
  *Professor, Department of Mechanical Engineering*  
  *Associate Dean for Research, Graduate Studies, and Computing*
Dr. Alexander Barzilov
Associate Professor,
Department of Mechanical Engineering
Alexander.Barzilov@unlv.edu

- Expertise
  - Radiation detection and spectroscopy
  - Active neutron interrogation and non-destructive assay of materials
  - Prompt gamma neutron activation analysis
  - Gamma ray spectral analysis and radiation source identification
  - Computational modeling of radiation transport and nuclear systems design and analysis
  - Nuclear applications of accelerators
Dr. Wolfgang Bein
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Wolfgang.Bein@unlv.edu

• Expertise
  • Sensor networks
  • Open Source Algorithm implementation
  • Survey articles on issues in security
  • Design of highly competitive online algorithms against different adversaries
  • Smart use of randomization
  • Approximations for hard combinatorial optimization problems

Top: A tour of the United States obtained through simulated annealing.
Bottom: Communication network design for the U.S.
National Security Engineering Research

Dr. William Culbreth
Associate Professor,
Department of Mechanical Engineering
William.Culbreth@unlv.edu

Mr. Robert O’Brien
Research Engineer,
Department of Mechanical Engineering

- Expertise
  - Computational modeling of radiation transport and nuclear criticality problems
  - Experimental assessment of radiation detectors
  - Active neutron interrogation and detection of Special Nuclear Material
  - Dense Plasma Focus accelerator development for neutron production
  - Design of alpha detectors for airflow measurements
  - UAV flights and novel radiation detector development for UAVs
  - Geologic nuclear reactor modeling

Top: MCNPX calculations provide a visual image of shipping container contents using a Varian x-ray accelerator.
Bottom: Computational fluid dynamics visualization of truck body aerodynamic drag reduction technology.
National Security Engineering Research

Dr. Thomas Hartmann
Associate Professor,
Department of Mechanical Engineering
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- **Expertise**
  - Synthesis and characterization of advanced nuclear fuels and materials.
  - Synthesis and properties of novel ceramic waste forms to immobilize radioactive high-level waste.
  - Crystal structure characterization by X-ray fine structure analysis and Rietveld structure refinement.
  - Determination of phase transitions by high-temperature X-ray diffraction.
  - High resolution electron microscopy using an analytical FE-TEM on irradiated and radioactive metals and ceramics.
  - Novel accelerator-based method to determine radiolytic product formation within the near-field of a generic geological repository.

*Top to bottom: Novel superconductors from high-level radioactive waste and high burn-up fuel; advanced $^{99}$Tc waste forms; and key instrumentation, including high-resolution XRD, FE-TEM, PPMS*
National Security Engineering Research

Dr. Yingtao Jiang
Associate Professor,
Department of Electrical and Computer Engineering
Yingtao.Jiang@unlv.edu

- Expertise
  - Sensors and Instrumentation
  - Signal processing, instrumentation, and medical informatics
  - Semiconductor/microelectronics/integrated circuits
  - Wireless communications and security
  - Computer/microprocessor architectures
  - Renewable energy

Yttria Stabilized Zirconia (YSZs) O₂ Sensor for monitoring nuclear reactor coolant

An MRR with E/O tuning circuit.

22-layer PCB board (NoC emulator)
Dr. Ju-Yeon Jo
Associate Professor,
Department of Computer Science
Juyeon.Jo@unlv.edu

• Expertise
  • Secure, reliable communication protocols for Unmanned Aerial Vehicles (UAVs)
  • Critical infrastructure / Smart Grid security
  • Man-In-The-Middle (MITM) attack with tempered SSL certificate detection
  • Thwarting Distributed Denial of Service (DDoS) attacks
  • Digital search warrants
  • Transportation security imaging and secure communication software development

A communication architecture with a two-level wireless mesh network that is secure and scalable.
National Security Engineering Research

Dr. Kwang J. Kim
Southwest Gas Professor of Energy and Matter
Department of Mechanical Engineering
Yingtao.Jiang@unlv.edu

- Expertise
  - Electroactive polymers for underwater applications
  - Electroactive polymers for aerospace applications
  - Electroactive polymers for ground applications

A bio-inspired fin using electroactive polymers, designed for underwater applications.
National Security Engineering Research

Dr. Yoohwan Kim, CISSP
Associate Professor,
Department of Computer Science
Yoohwan.Kim@unlv.edu

• Expertise
  • Secure protocol development for software and network applications
  • Critical infrastructure / Smart Grid security and privacy
  • Wireless mesh network routing and security
  • Distributed Denial of Service (DDoS) attack prevention
  • Secure and reliable communication scheme for unmanned aerial vehicles (UAVs)
  • Airport security inspection software design and DICOS standard development
  • Insider threat detection
National Security Engineering Research

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Co-Director, Center for Information Technology and Algorithms (CITA)
Shahram.Latifi@unlv.edu

- Expertise
  - Search and rescue
  - Disaster relief
  - Homeland Security
  - Nuclear non-proliferation
  - Biometrics
Dr. Brendan O’Toole
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Director, Mendenhall Innovation Program
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• Expertise
  • Structural analysis, failure analysis, experimental mechanics
  • Structural dynamics, explosives, and impact analysis
  • Computational simulation of highly dynamic events
  • Material characterization, custom component testing

Dr. Mohamed Trabia
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High Strength Steel for Endcaps
Internal Baffling to Distribute Blast Wave
Light Composite for Containment Strength
National Security Engineering Research

Dr. Emma Regentova
Professor, Department of Electrical and Computer Engineering
Emma.Regentova@unlv.edu

• Expertise
  • Pulsed-ray radioscopy to detect nuclear materials
  • Radioscopic cargo screening using mega-voltage energy barriers

Top: Architecture of the dual-energy pulsed accelerator. Bottom left: 9 MeV images of shielded HiZ materials, including uranium. Bottom right: Use of the ratio of 6 and 9 MeV in combination to reveal the treat.
National Security Engineering Research

Dr. Stephen Rice, CPHIT, P.E.
Professor,
Department of Mechanical Engineering
Stephen.Rice@unlv.edu

• Expertise
  • Security and privacy of health records
  • Secure Electronic Records System (ERS)
  • HIPAA privacy and security rules
  • Security policy and procedures to ensure legal compliance

Top: Flowchart of high-level system architecture for an Electronic Records System (ERS).
Bottom left: A watermark to ensure that no change can be made to any official record stored in the ERS.
Bottom right: Some of the functionality of the ERS.
National Security Engineering Research

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Dr. Ying Tian, P.E.
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- Expertise
  - Progressive collapse resistance of structures
  - Large-scale testing of structural components and systems
  - Simulation of structures subjected to normal and extreme loading events
  - Earthquake engineering

[Images of structural diagrams and testing equipment]
National Security Engineering Research

Dr. Robert Schill
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Director, Center for Energy Materials Interaction Technology Initiative of Nevada (EMITION)

Robert.Schill@unlv.edu
• Expertise
  • Electromagnetics
  • Pulsed power and plasma physics
  • Microwaves and optics
  • Materials science

The Nevada Shocker is a pulse-power device used to study material in a harsh electromagnetic environment
National Security Engineering Research

Dr. Ke-Xun (Kevin) Sun
Professor,
Department of Electrical and Computer Engineering
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• Expertise
  • GaN semiconductors and devices
  • Radiation-hard electronics, optoelectronics, and imaging systems
  • Optics and diffractive optics
  • Ultrafast lasers and electronics
  • Image analysis
  • High Energy Density Physics (HEDP) diagnostics
  • CubeSats and formation flight
  • Science payload instruments

Photodiode response retained 50% at Fluence $3 \times 10^{12}$ protons/cm$^2$
National Security Engineering Research
Faculty CVs and Publications
National Security Engineering Research

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- Expertise
  - Radiation detection and spectroscopy
  - Active neutron interrogation and non-destructive assay of materials
  - Prompt gamma neutron activation analysis
  - Gamma ray spectral analysis and radiation source identification
  - Computational modeling of radiation transport and nuclear systems design and analysis
  - Nuclear applications of accelerators
National Security Engineering Research

Dr. Alexander Barzilov
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Recent Publications


National Security Engineering Research

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- Expertise
  - Sensor networks
  - Open Source Algorithm implementation
  - Survey articles on issues in security
  - Design of highly competitive online algorithms against different adversaries
  - Smart use of randomization
  - Approximations for hard combinatorial optimization problems

Top: Coverage models for sensor networks.
Bottom: Design of a competitive randomized online algorithm using knowledge states.
National Security Engineering Research

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Recent Publications

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Expertise
- Computational modeling of radiation transport and nuclear criticality problems
- Experimental assessment of radiation detectors
- Active neutron interrogation and detection of Special Nuclear Material
- Dense Plasma Focus accelerator development for neutron production
- Design of alpha detectors for airflow measurements
- UAV flights and novel radiation detector development for UAVs
- Geologic nuclear reactor modeling

Top: Varian Cargo Scanning System to identify actinides in shipping containers.
Bottom: UNLV unmanned aerial vehicle (UAV) flights at the Nevada National Security Site (NNSS) to test heavy diesel fuel engines.
National Security Engineering Research

Dr. William Culbreth
Associate Professor,
Department of Mechanical Engineering

Recent Publications

National Security Engineering Research

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- Expertise
  - Synthesis and characterization of advanced nuclear fuels and materials.
  - Synthesis and properties of novel ceramic waste forms to immobilize radioactive high-level waste.
  - Crystal structure characterization by X-ray fine structure analysis and Rietveld structure refinement.
  - Determination of phase transitions by high-temperature X-ray diffraction.
  - High resolution electron microscopy using an analytical FE-TEM on irradiated and radioactive metals and ceramics.
  - Novel accelerator-based method to determine radiolytic product formation within the near-field of a generic geological repository.
Recent Publications

National Security Engineering Research

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• Expertise
  • Sensors and Instrumentation
  • Signal processing, instrumentation, and medical informatics
  • Semiconductor/microelectronics/integrated circuits
  • Wireless communications and security
  • Computer/microprocessor architectures
  • Renewable energy
Dr. Yingtao Jiang
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Recent Publications

National Security Engineering Research

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- Expertise
  - Secure and Reliable Communication Protocol for Unmanned Aerial Vehicles (UAVs)
  - Critical infrastructure / Smart Grid security
  - Man-In-The-Middle (MITM) attack with a tempered SSL certificate detection
  - Thwarting Distributed Denial of Service (DDoS) attacks
  - Digital search warrant
  - Transportation security imaging and secure communication software development
National Security Engineering Research

Dr. Ju-Yeon Jo
Associate Professor,
Department of Computer Science

Recent Publications

• Kevin Benton, Ju-Yeon Jo, and Yoohwan Kim, “SignatureCheck: A Protocol to Detect Man-In-The-Middle Attack in SSL”, 7th Annual Cyber Security and Information Intelligence Research Workshop, Oak Ridge, TN, Oct. 2011


National Security Engineering Research

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Web: www.kwangjjinkim.org
Youtube: http://www.youtube.com/user/kwangkimlab
Publications: http://scholar.google.com/citations?user=VX3wtWEAAAAJ&hl=en

- Expertise
  - Electroactive polymers for underwater applications
  - Electroactive polymers for aerospace applications
  - Electroactive polymers for ground applications
National Security Engineering Research

Dr. Kwang J. Kim
Southwest Gas Professor of Energy and Matter
University of Nevada, Las Vegas (UNLV)

Recent publications relevant to National Security Engineering


Security Engineering Research

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• Expertise
  • Secure protocol development for software and network applications
  • Critical infrastructure / Smart Grid security and privacy
  • Wireless mesh network routing and security
  • Distributed Denial of Service (DDoS) attack prevention
  • Secure and reliable communication scheme for unmanned aerial vehicles (UAVs)
  • Airport security inspection software design and DICOS standard development
  • Insider threat detection
Security Engineering Research

Dr. Yoohwan Kim
Associate Professor,
Department of Computer Science

Recent Publications

• Yoohwan Kim, Frederick Sheldon, and Lee Hively, “Anomaly Detection in Multiple Scale for Insider Threat Analysis”, 7th CSIIRW, Oct. 2011
• Kevin Benton, Juyeon Jo, and Yoohwan Kim, “SignatureCheck: A Protocol to Detect Man-In-The-Middle Attack in SSL”, 7th CSIIRW, Oct. 2011
Security Engineering Research

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- Expertise
  - Search and rescue
  - Disaster relief
  - Homeland Security
  - Nuclear non-proliferation
  - Biometrics
Security Engineering Research

Dr. Shahram Latifi, P.E.
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Recent Publications

• D. Walker and S. Latifi, “Software Reliability in Data Portals for Climate Change in Nevada”, 19th Int’l Conf. on Software Eng. and Data Eng, June 2010, pp. 140-144.
Security Engineering Research

Dr. Brendan O’Toole
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• Expertise
  • Structural analysis, failure analysis, experimental mechanics
  • Structural dynamics, explosives, and impact analysis
  • Computational simulation of highly dynamic events
  • Material characterization, custom component testing
Security Engineering Research

Dr. Brendan O’Toole
Professor,
Department of Mechanical Engineering
Director, Mendenhall Innovation Program

Recent Publications

Security Engineering Research

Dr. Emma Regentova
Professor, Department of Electrical and Computer Engineering

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University of Nevada, Las Vegas
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Phone: (702) 895-3169
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- Expertise
  - Pulsed-ray radioscopy to detect nuclear materials
  - Radioscopic cargo screening using megavoltage energy barriers
Dr. Emma Regentova
Professor, Department of Electrical and Computer Engineering

Recent Publications


Security Engineering Research

Dr. Stephen Rice
Professor,
Department of Mechanical Engineering

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University of Nevada, Las Vegas
4505 S. Maryland Parkway
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- Expertise
  - Security and privacy of health records
  - Secure Electronic Records System (ERS)
  - HIPAA privacy and security rules
  - Security policy and procedures to ensure legal compliance
Security Engineering Research

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• Expertise
  • Progressive collapse resistance of structures
  • Large-scale testing of structural components and systems
  • Simulation of structures subjected to normal and extreme loading events
  • Earthquake engineering
Dr. Aly Said
Assistant Professor,
Department of Civil and Environmental Engineering and Construction

Recent Publications


Dr. Robert Schill
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Email: Robert.Schill@unlv.edu

• Expertise
  • Electromagnetics
  • Pulsed power and plasma physics
  • Microwaves and optics
  • Materials science
Security Engineering Research

Dr. Robert Schill
Professor,
Department of Electrical and Computer Engineering
Director, Center for the Energy Materials Interaction Technology Initiative (EMITION)

Recent Publications


Patents

Security Engineering Research

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- Expertise
  - GaN semiconductors and devices
  - Radiation-hard electronics, optoelectronics, and imaging systems
  - Optics and diffractive optics
  - Ultrafast lasers and electronics
  - Image analysis
  - High Energy Density Physics (HEDP) diagnostics
  - CubeSats and formation flight
  - Science payload instruments
Security Engineering Research

Dr. Ke-Xun (Kevin) Sun
Professor,
Department of Electrical and Computer Engineering

Recent Publications


Patents

Security Engineering Research

Dr. Ying Tian, P.E.
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- Expertise
  - Progressive collapse resistance of structures
  - Large-scale testing of structural components and systems
  - Simulation of structures subjected to normal and extreme loading events
  - Earthquake engineering
Recent Publications

Security Engineering Research

Dr. Mohamed Trabia
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- Expertise
  - Structural analysis, failure analysis, experimental mechanics
  - Structural dynamics, explosives, and impact analysis
  - Computational simulation of highly dynamic events
  - Material characterization, custom component testing
Security Engineering Research

Dr. Mohamed Trabia
Professor,
Department of Mechanical Engineering
Associate Dean for Research, Graduate Studies, and Computing

Recent Publications

# Security Engineering Research

## Additional Resources

<table>
<thead>
<tr>
<th>Center for Materials and Structures</th>
<th><a href="http://www.unlv.edu/engineering/cmsd">http://www.unlv.edu/engineering/cmsd</a></th>
</tr>
</thead>
<tbody>
<tr>
<td>Center for the Advanced Study of Algorithms (CASA)</td>
<td><a href="http://www.egr.unlv.edu/~bein/casa/">http://www.egr.unlv.edu/~bein/casa/</a></td>
</tr>
<tr>
<td>Center for Information Technology and Algorithms (CITA)</td>
<td><a href="http://www.unlv.edu/engineering/cita">http://www.unlv.edu/engineering/cita</a></td>
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