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## Curriculum Vitae

of

## Tarek Echecki

Senior Advisor,

[EnviroComp Consulting, Inc.](#)



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## EDUCATION AND TITLES

- *Doctor of Philosophy in Mechanical Engineering, **Stanford University**, Stanford, California (1993)*
  - ***Dissertation: Studies of Curvature, Strain and Unsteady Effects on Premixed Flames***

Advisor: Prof. Joel H. Ferziger  
Co-Advisor: Prof. M. Godfrey Mungal
- *Master of Science in Mechanical Engineering, **Stanford University**, Stanford, California (1987)*
  - ***Depth Areas:** Applied Thermodynamics, Combustion and Fluid Dynamics, High Temperature Gas Dynamics*
- *Bachelor of Science in Mechanical Engineering, **Washington University**, St. Louis, Missouri (1985)*

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## PROFESSIONAL EXPERIENCE

- *Senior Advisor, EnviroComp Consulting, Inc. (2002 – present)*  
[www.envirocomp.com](http://www.envirocomp.com)
- *Associate **Professor**, Mechanical and Aerospace Engineering Department, North Carolina State University, Raleigh, North Carolina (2002 – present)*
- *Member of the Technical Staff, Combustion Research Facility, **Sandia National Laboratories**, Livermore, California (5/1998 - 12/2001)*
- *Visiting Assistant Research Engineer, **University of California-Berkeley**, Berkeley, and **Sandia National Laboratories**, Livermore, California (1/1997 - 5/1998)*
- *Post-Doctoral Research Fellow, Combustion Research Facility, **Sandia National Laboratories**, Livermore, California (9/1994 - 11/1996)*
- *Post-Doctoral Research Fellow, Centre de Recherche sur la Combustion Turbulente, **The French Petroleum Institute** (Institut Français du Pétrole), Rueil-Malmaison, France (additional affiliation with **Ecole Centrale Paris**) (12/1992 – 6/1994)*
- *Research Assistant (Ph.D. Thesis), **Stanford University**, Stanford, California (9/1987 –*

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11/1992)

- **Research Assistant, Stanford University**, Stanford, California (6/1986 – 9/1986)
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## **MEMBERSHIPS/PROFESSIONAL ACTIVITIES**

- **Society Membership:** The Combustion Institute • the American Society of Mechanical Engineers
  - **Other Affiliations:** Applied Energy Laboratory and High-Performance Computing Center (both at NC State University)
  - **Journal Reviewer:** Combustion & Flame • Combustion Theory & Modelling • AIAA Journal • ASME J. Fluid Engineering • Proceedings of Combustion Institute • Combustion Science and Technology • Physics of Fluids • Journal of Micromechanics and Microengineering • Continuum Mechanics and Thermodynamics • International Journal of Heat and Mass Transfer • Journal of Engineering of Gas Turbines and Power • Progress in Energy and Combustion Science • Environmental Forensics Journal.
  - **Proposal Reviewer:** National Science Foundation Proposal Reviewer and Panelist in Chemical and Transport Systems (CTS) • National Science Foundation Proposal Panelist in Mathematical Sciences (DMS) • San Diego State University Foundation • the Petroleum Research Fund of the American Chemical Society (ACS/PRF) • the US Army Research Office (ARO) • the US Department of Energy (DOE) Innovative and Novel Computational Impact on Theory and Experiment (INCITE) program • the US Department of Energy (DOE) Basic Energy Sciences Grants program.
  - **Service:** Department Committees member (Department of Mechanical and Aerospace Engineering at North Carolina State University): Graduate, Undergraduate Curriculum, Faculty Honors and Awards, Energy Faculty Search Committee • College Committees member (College of Engineering at North Carolina State University): Computer Committee • University Committee member (North Carolina State University): Faculty-at-Large Representative at the Tuition Committee Advisory Committee chaired by the Provost.
  - **Graduate Student Theses Directed at NC State University:**
    - 4 M.S. in Mechanical Engineering Completed • 3 of which are pursuing/completing a PhD degree
    - 5 Ph.D. • 3 Completed • 2 in process.
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- **Other Mentorship Experience**

- Membership in Thesis Committee of at least 10 more students at NC State
  - Mentorship of graduate students at Stanford University, Ecole Centrale-Paris/Institut Francais du Pétrole (France), Sandia National Laboratories visitors and University of California at Berkeley.
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## **AWARDS**

- Winning poster presented at the American Physical Society Annual Meeting, Fluid Dynamics Division, Palo Alto, California, December 1989: Particle Tracking in a Laminar Premixed Flame • Work at Sandia was featured five (5) times in Sandia's Combustion Research Facility News.
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## **RESEARCH INTERESTS**

- Modeling and Simulation of Turbulent Reacting Flows/Computational Combustion
  - Large-Eddy Simulations
  - Combustion and Fire Science (Theory and Dynamics)
  - Multi-Scale Modeling of Physical Processes
  - Micro-Scale Combustion and Miniaturized Energy Systems
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## **TEACHING EXPERIENCE PRIOR TO NC STATE**

I lectured in discussion sessions and taught graduate-level courses in the following areas at the Mechanical Engineering Department, Stanford University:

- Solar Energy Applications/Building Energetics
- Advanced Fluid Engineering A/B
- Mathematical Methods in Mechanical Engineering: Linear algebra, Partial differential equations, Numerical Analysis

## **PRESENT TEACHING RESPONSIBILITIES**

- Engineering Thermodynamics I & II (UG) (Course Numbers: MAE 301, MAE 302)
  - Engineering Fluid Mechanics (UG) (Course Numbers: MAE 308)
  - Fluid Dynamics (G) (Course Numbers: MAE 550)
  - Combustion I & II (G) (Course Numbers: MAE 504, MAE 704)
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- Undergraduate Research Projects (UG) (Course Numbers: MAE 496)
  - Additional Teaching Interests: Energy Conversion (UG), Computational Fluid Dynamics (G), Mathematical Methods in Engineering (G), Turbulent Flows (G).

## REFEREED JOURNAL PUBLICATIONS

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- Cao, S., and **Echekki, T.**, A Structure-Based Approach for the Large-Eddy Simulation of Mixing and Combustion Flows Based on the One-Dimensional Turbulence Model, *Physics of Fluids*, under Review, 2006.
- Cao, S., and **Echekki, T.**, Three-Dimensional Simulation of Autoignition in Non-Homogeneous Mixtures, *Combustion and Flame*, under Review, 2006.
- **Echekki, T.**, and Kolera-Gokula, H., A Regime Diagram for Flame Kernel-Vortex Interactions and Implications for Turbulent Combustion, *Physics of Fluids*, under Review, 2006.
- Kolera-Gokula, H., and **Echekki, T.**, On the Coupling between Transport and Chemistry during Downstream Flame Interactions, *Combustion Science and Technology*, under Review, 2006.
- Ranganath, B., and **Echekki, T.**, Effects of Preferential and Differential Diffusion on the Mutual Annihilation of Two-Premixed Stoichiometric Propane-Air Flames, *International Journal of Heat and Mass Transfer*, Vol. 49, pp. 5075-5080, 2006.
- Ranganath, B. and **Echekki, T.**, An ODT-Based Closure Model in Non-Premixed Combustion, *Progress in Computational Fluid Dynamics*, Vol. 6, pp. 409-418, 2006.
- Kolera-Gokula, H. and **Echekki, T.**, Direct Numerical Simulation of Flame Kernel-Vortex Interactions in Hydrogen-Air Mixtures, *Combustion and Flame*, Vol. 146, pp. 155-167, 2006.
- Danby, S., and **Echekki, T.**, Proper Orthogonal Decomposition Analysis of Autoignition Simulation Data of Non-Homogeneous Hydrogen-Air Mixtures, *Combustion and Flame*, Vol. 144, pp. 126-138, 2006.
- Ranganath, B. and **Echekki, T.**, Effects of Preferential and Differential Diffusion on the Mutual Annihilation of Two Premixed Hydrogen Air Flames, *Combust. Theory and Modelling*, Vol. 9, 2005.
- **Echekki, T.** and Chen, J.-Y., and Hegde, U., Numerical Investigation of Buoyancy Effects on Triple Flame Stability, *Combustion Science and Technology*, Vol. 176, pp. 381-407, 2004.
- **Echekki, T.** and Chen, J.H., Direct Numerical Simulations of Auto-ignition in Non-homogeneous Hydrogen-Air Mixtures, *Combustion and Flame*, Vol. 134, p. 169, 2003.
- **Echekki, T.** and Chen, J.H., High-Temperature Combustion in Autoigniting Non-Homogeneous Hydrogen-Air Mixtures, *Proceedings of the Combustion Institute*, Vol. 29, pp. 2061-2068, Part 2, 2002.

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- **Echekki, T.**, Kerstein, A.R., Chen, J.Y., Dreeben, T., “One-Dimensional Turbulence” Simulation of Turbulent Jet Diffusion Flames, *Combustion & Flame*, Vol. 125, pp. 1083-1105, 2001.
  - Chen, J.Y. and **Echekki, T.**, Numerical Study of Buoyancy Effects on Triple Flames, *Combustion Theory and Modelling*, Vol. 5, pp. 499-515, 2001.
  - Chen, J.H., **Echekki, T.** and Kollman, W., The Mechanism of Two-Dimensional Pocket Formation in Lean Premixed Methane-Air Flames with Implications to Turbulent Combustion, *Combustion & Flame*, Vol. 116, pp. 15-48, 1999.
  - **Echekki, T.** and Chen, J.H., Analysis and Computation of the Contributions to the Propagation of Turbulent Premixed Methane-Air Flames, *Combustion & Flame*, Vol. 118, pp. 308-311, 1999.
  - **Echekki, T.** and Chen, J.H., Structure and Propagation of Methanol-Air Triple Flames, *Combustion & Flame*, Vol. 114, pp. 231-245, 1998.
  - Peters, N., Terhoeven, P., Chen, J.H. and **Echekki, T.**, Statistics of Flame Displacement Speeds from Computations of 2-D Unsteady Methane-Air Flames, *Proceedings of the Combustion Institute*, Vol. 27, pp. 833-839, 1998.
  - **Echekki, T.**, A Quasi-One Dimensional Premixed Flame Model with Cross-Stream Diffusion, *Combustion & Flame*, Vol. 110, pp. 335-350, 1997.
  - **Echekki, T.** and Chen, J.H., Unsteady Strain Rate and Curvature Effects on Turbulent Premixed Flames, *Combustion & Flame*, Vol. 106, pp. 184-202, 1996.
  - **Echekki, T.**, Chen, J.H. and Gran, I.R., On the Mechanism of Mutual Flame Annihilation in Stoichiometric Methane-Air Flames, *Proceedings of the Combustion Institute*, Vol. 26, pp. 855-863, 1996.
  - Gran, I.R., **Echekki, T.** and Chen, J.H., Negative Burning in Turbulent Premixed Flames: A Computational Study, *Proceedings of the Combustion Institute*, Vol. 26, pp. 323-329, 1996.
  - Ferziger, J.H. and **Echekki, T.**, A Simplified Reaction Rate Model and its Application to Laminar Premixed Flames, *Combustion Science & Technology*, Vol. 89, pp. 293-315, 1993.
  - **Echekki, T.** and Ferziger, J.H., Studies of Curvature Effects on Laminar Premixed Flames: Stationary Cylindrical Flames, *Combustion Science and Technology*, Vol. 90, pp. 231-252, 1993.
  - Poinso, T., **Echekki, T.** and Mungal, M.G., A Study of the Laminar Flame Tip and Implications for Premixed Turbulent Combustion, *Combustion Science & Technology*, Vol. 81, pp. 45-73, 1992.
  - **Echekki, T.** and Mungal, M.G., Flame Speed Measurements at the Tip of a Slot Burner: Effects of Flame Curvature and Hydrodynamic Stretch, *Proceedings of the Combustion Institute*, Vol. 23, p. 1530, 1990.
  - **Echekki, T.** and Mungal, M.G., Particle Tracking in a Laminar Premixed Flame, *Physics of Fluids A* Vol. 2, September 1990, p. 1523.
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## CHAPTERS IN EDITED BOOKS

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- **Echekki, T.**, Poinso, T., Baritaud, T. and Baum, M., Simulation of Flame Kernel Evolution in a Turbulent Isotropic Flow, in Direct Numerical Simulations for Turbulent Reacting Flows (Th. Baritaud, Th. Poinso and M. Baum, Eds.), pp. 123-146, Editions Technip, Paris, France (1996).
- Hewson, J., **Echekki, T.**, and Kerstein, A.R., One-Dimensional Stochastic Simulation of Advection-Diffusion-Reaction Coupling in Turbulent Combustion, Turbulent Mixing and Combustion, Kluwer Academic Publishers, 2002.

## REFEREED ARTICLES IN PROCEEDINGS

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- Chen, J.Y., **Echekki, T.** and Hegde, U., Effects of Gravity on Triple Flame Propagation and Stability, Proceedings of the International Microgravity Combustion Workshop, Vol. 6, NASA/CP-2001-210826, pp. 349-352, 2001.
- Chen, J.Y. and **Echekki, T.**, Buoyancy and Differential Diffusion Effects on the Structure and Dynamics of Triple Flames, Proceedings of the International Microgravity Combustion Workshop, Vol. 5, pp. 427-430, Cleveland, Ohio, 1999.
- **Echekki, T.**, Poinso, T., Baritaud, T. and Baum, M., Modeling and Simulation of Flame Kernel Evolution in a Turbulent Isotropic Flow, in Transport Processes in Combustion, (S.H. Chan, Ed.), Vol. 2, pp. 951-962, Taylor and Francis (1996).
- **Echekki, T.** and Chen, J.H., The Effects of Complex Chemistry on Triple Flames, in Studying Turbulence using Numerical Simulation Databases, Center of Turbulence Research, Stanford University-NASA Ames, pp. 217-234 ( 1996).
- **Echekki, T.**, Chen, J.H., Card, J. and Mahalingam, S., Direct Numerical Simulations of Premixed Methane-Air Flames Modeled with Reduced Kinetics, Plenary Session, Volume 1, p. 1-7, Tenth Symposium on Turbulent Shear Flows, Penn State, University Park, PA, August 14-16, 1995.

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## ARTICLES IN NON-REFEREED CONFERENCES AND PROCEEDINGS

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- **Echekki, T.**, Chen, J.H., Effects of Curvature and Unsteady Strain Rate on Turbulent Premixed Methane-Air Flames, Western States Section of the Combustion Institute, Fall Meeting, Stanford University, Stanford, CA, October 30-31, Paper 95-216, 1995.
- **Echekki, T.**, Poinso, T., Baritaud, T., and Baum, M., Modeling and Simulation of Turbulent Flame Kernel Evolution, The Eighth International Symposium on Transport Phenomena in Combustion, San Francisco, CA, July 16-20, 1995.

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- Chen, J.H. and **Echekki, T.**, Pocket Formation in Turbulent Lean Methane-Air Flames, Western States Section of the Combustion Institute, Spring Meeting, April 14-15, 1997, Livermore, CA, Paper 97S-055.
  - **Echekki, T.** and Chen, J.H., Structure and Propagation of Methanol-Air Triple Flames, Western State States Section of the Combustion Institute, Spring Meeting, April 14-15, 1997, Livermore, CA, Paper 97S-021.
  - **Echekki, T.**, A Quasi-One Dimensional Premixed Flame Model with Cross-Stream Diffusion, Western State States Section of the Combustion Institute, Spring Meeting, April 14-15, 1997, Livermore, CA, Paper 97S-027.
  - Chen, J.H., **Echekki, T.**, and Im, H.G., Direct Numerical Simulation of Turbulent Flames, 215th National ACS Meeting, Dallas, Texas, March 29-April 1, 1998.
  - Chen, J.Y., and **Echekki, T.**, Numerical Study of Buoyancy and Differential Diffusion Effects on the Structure and Dynamics of Triple Flames, Presented at the NASA Micro-gravity Combustion Workshop, Cleveland, Ohio, 1999.
  - Chen, J.Y. and **Echekki, T.**, Effects of Gravity on Triple Flames, Western-States Section of the Combustion Institute, Spring Meeting, March 13, 2000.
  - **Echekki, T.** and Chen, J.H., Direct Numerical Simulation of Autoignition in Inhomogeneous Hydrogen-Air Mixtures, 2<sup>nd</sup> Joint Meeting of the US Sections of the Combustion Institute, March 25-27, 2001.
  - Chen, J.Y., **Echekki, T.** and Hegde, U., Effects of Gravity on Triple Flame Stability, 2<sup>nd</sup> Joint Meeting of the US Sections of the Combustion Institute, March 25-27, 2001.
  - **Echekki, T.**, Stochastic Simulation of Autoignition in Non-Homogeneous Hydrogen-Air Mixtures, 2<sup>nd</sup> Joint Meeting of the US Sections of the Combustion Institute, March 25-27, 2001.
  - Chen, J.Y., **Echekki, T.** and Hegde, U., Effects of Gravity on Triple Flame Propagation and Stability, 6<sup>th</sup> International Microgravity Combustion Workshop, May 22-24, 2001.
  - Hewson, J., **Echekki, T.**, and Kerstein, A.R., One-Dimensional Stochastic Simulation of Advection-Diffusion-Reaction Coupling in Turbulent Combustion, Presented at the IUTAM Symposium on Turbulent Mixing and Combustion, Kingston, Ontario, Canada, June 3-6, 2001.
  - DeBruhl, C.D., **Echekki, T.**, and Roberts, W.L., NO<sub>x</sub> Measurements in an Unsteady Counterflow Diffusion Flame, The Third Joint Meeting of the U.S. Sections of the Combustion Institute, Chicago, March 16,-19, 2003.
  - **Echekki, T.**, Kerstein, A.R., and Chen, J.Y., One-Dimensional Turbulence Simulation of Extinction and Re-Ignition Predictions in Piloted Methane-Air Jet Diffusion Flames, The Third Joint Meeting of the U.S. Sections of the Combustion Institute, Chicago, March 16,-19, 2003.
  - Zhang, S., and **Echekki, T.**, One-Dimensional Turbulence Simulation of Turbulent Jet Diffusion Flames of Hydrogen with Helium Dilution, The Third Joint Meeting of the U.S. Sections of the Combustion Institute, Chicago, March 16,-19, 2003.



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- Ranganath, B., and **Echekki, T.**, Effects of Differential Diffusion on the Mutual Annihilation of Two Stoichiometric Premixed Hydrogen-Air Flames, Eastern States Section of the Combustion Institute Fall 2003 Meeting, The Pennsylvania State University, October 26-29, 2003.
  - Cao, S. and **Echekki, T.**, 3D Simulation of Autoignition in Non-Homogeneous Mixtures in Homogeneous, Isotropic Turbulence and Validation with the Conditional Moment Closure Model, The Fourth Joint Meeting of the U.S. Sections of the Combustion Institute, Philadelphia, PA, 2005.
  - Kolera-Gokula, H., and **Echekki, T.**, Study of Mutual Flame Annihilation Effects during Flame Kernel-Vortex Interactions, The Fourth Joint Meeting of the U.S. Sections of the Combustion Institute, Philadelphia, PA, 2005.

## CONFERENCES AND PROCEEDING ABSTRACTS

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- **Echekki, T.**, A Novel Large-Eddy Simulation Approach for Turbulent Mixing and Combustion, Tenth SIAM International Conference on Numerical Combustion, Sedona, AZ, May 9-12, 2004.
  - **Echekki, T.**, Kerstein, A.R. and Chen, J.Y., One-Dimensional Turbulence Simulation of Jet Diffusion Flames, in the Tenth International Conference on Numerical Combustion, Amelia Island, Florida, March 5-8, 2000.
  - Chen, J.H., **Echekki, T.** and Kollmann, W., Mechanisms of Pocket Formation in a 'Turbulent' Premixed Methane-Air Flame, Fifty-First Annual American Physical Society/DFD Meeting, San Francisco, Nov. 23-25, 1998.
  - **Echekki, T.** and Chen, J.H., Direct Numerical Simulation of a Laminar Methanol Triple Flames, Forty-Ninth Annual American Physical Society/DFD Meeting, Syracuse University, Syracuse, Nov. 24-26, 1996.
  - **Echekki, T.** and Chen, J.H., On Some Quenching Processes in Methane-Air Premixed Flames, in Sixth International Conference on Numerical Combustion, March 4-6, New Orleans, 1996.
  - **Echekki, T.**, Chen, J.H., and Gran, I.R., Direct Numerical Simulations of Turbulent Premixed Methane-Air Flames, in Sixth International Conference on Numerical Combustion, New Orleans, March 4-6, 1996.
  - **Echekki, T.** and Chen, J.H., Unsteady Strain Rate and Curvature Effects in Turbulent Premixed Flames, Forty-Eighth Annual American Physical Society/DFD Meeting, University of California, Irvine, Nov. 18-21, 1995.
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## PLENARY AND INVITED LECTURES (SINCE 1995)

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- **Echekki, T.**, Studies of Auto-ignition Phenomena in Turbulent Non-Homogeneous Media. Presented at the Mechanical Engineering Department, University of Victoria, British Columbia, Canada, April 3, 2001.
  - **Echekki, T.**, Turbulent Combustion: From High-Fidelity Simulations to Models, Fluid Mechanics Seminar, University of Toronto, January 12, 2001.
  - **Echekki, T.**, Turbulent Combustion from Direct Numerical Simulations to Models for Practical Combustion Devices, Presented at the Mechanical Engineering Department, Michigan State University, May 12, 2000.
  - **Echekki, T.**, One-Dimensional Turbulence Simulation of Reacting and Geophysical Flows, Presented at the Center for Environmental and Applied Fluid Mechanics, The Johns Hopkins University, January 28, 2000.
  - **Echekki, T.**, LES Applications in Combustion, Presented at the Fourth International Workshop on Turbulent Nonpremixed Flames, Darmstadt, Germany, June 27-29, 1999.
  - **Echekki, T.**, Chen, J.H., Card, J. and Mahalingam, S., Direct Numerical Simulations of Premixed Methane-Air Flames Modeled with Reduced Kinetics, Plenary Session, Presented at the Tenth Symposium on Turbulent Shear Flows, Penn State, University Park, PA, August 14-16, 1995.
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## TECHNICAL REPORTS

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- Haroldsen B., Chen J., Morales A.M., Hekmaty M.A., Krafcik K.L., Raber T., Mills B., Ceremuga J.T., **Echekki T.**, Lee J., Liu S., Karpetsis A., Design and fabrication of a meso-scale Stirling engine and combustor, Sandia Report SAND2005-2340, 2005.
  - Chen, J. H., Hewson, J. C., Kerstein, A.R., Kennedy, C. A., **Echekki, T.**, and Oefelein, J. C., Control strategies for Homogeneous Charge Compression Ignition Engines: LDRD Final Report, Sandia Report 2003-8124, 2003.
  - **Echekki, T.**, Modélisation et Simulation Numérique Directe de l'Allumage d'une Flamme Turbulente (Modeling and Numerical Simulation of Ignition in a Turbulent Flame), Institut Français du Pétrole, Report 41 525, August 1994.
  - **Echekki, T.**, Studies of Curvature, Strain and Unsteady Effects on Premixed Flames, PhD Thesis, Mechanical Engineering Department, Stanford University, 1993.
  - Poinso, T.J., **Echekki, T.**, and Mungal, M.G., A Study of the Laminar Flame Tip and Implications for Premixed Turbulent Combustion, Center for Turbulence Research manuscript 111, Stanford University/NASA Ames, 1990.
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## RELEVANT PROFESSIONAL ACTIVITY

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**Recent Testimony or Deposition**

Dr Echekeki has not provided depositions or trial testimony in the last four years.