

# GOKHAN KIRKIL

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## Education:

**Doctor of Philosophy, Civil and Environmental Engineering, 2008**

**The University of Iowa, USA**

Speciality: Computational Fluid Dynamics and Environmental Fluid Mechanics

Advisors: Dr. George Constantinescu & Dr. Robert Ettema

**Master of Science, Civil and Environmental Engineering, 2004**

**The University of Iowa, USA**

Speciality: Experimental Fluid Dynamics

Advisor: Dr. Robert Ettema

**Bachelor of Science, Civil Engineering, 2002**

**Middle East Technical University, Turkey**

## Research Interests:

- Fluid mechanics with applications to environmental and energy related problems.
- Atmospheric flows and boundary layers.
- Renewable energy systems; particularly wind-power and hydro-power.
- Particulate flows; transport of contaminants, pollutants and aerosols in environment.
- Computational Fluid Dynamics, particularly, Large Eddy Simulation (LES) and Detached Eddy Simulation (DES) for flows in complex geometries. Applications in renewable energy systems, industrial and environmental flows.
- Algorithm development, turbulence modeling for complex turbulent flows.
- Parallel and large scale computing.
- Advanced experimental methods, particularly Particle Image Velocimetry (PIV).

## Research and Teaching Experience:

### **Postdoctoral Research Staff Member**

*January 2009-present*

#### **Lawrence Livermore National Laboratory, USA**

- Performed multi-scale, multi-physics nested atmospheric boundary layer simulations using Weather Research and Forecasting (WRF) model. Investigated the flow transition problems at mesoscale/large eddy simulation interfaces which is important for downscaling wind velocity and scalar fields from mesoscale simulations.
- Implemented advanced sub-filter scale models into the WRF's Large Eddy Simulation module in order to improve multi-scale flow predictions at atmospheric boundary layers under complex terrain and stability conditions.
- Analyzed the wind speed and power measurement data collected over two years from an offshore wind farm located in south Denmark to validate several wind turbine parameterizations implemented in WRF.

### **Graduate Research Assistant**

*May 2004-August 2008*

#### **IIHR Hydroscience & Engineering, The University of Iowa, USA**

- Parallelized a finite-difference Navier-Stokes solver (RANS/DES) and subroutines used to perform RANS/DES simulations with movable bed, free surface and contaminant transport.
- Used highly resolved LES to investigate the role of coherent structures in the turbulent flow past circular and high aspect ratio rectangular cylinders (i.e. junction flows).
- Performed experimental flow studies and flow visualizations to validate findings of LES and DES simulations of flow around wall mounted structures. Main techniques used are Particle Image Velocimetry (PIV), Acoustic Doppler Velocimetry (ADV) and dye visualizations.
- Investigated turbulent shallow mixing layers using highly resolved DES simulations. In particular, focused on effect of flow depth, bottom roughness and scalar transport.

### **Graduate Research Assistant**

*August 2002-May 2004*

#### **IIHR Hydroscience & Engineering, The University of Iowa, USA**

- Investigated the scaling effect in experiments on local sediment transport around wall-mounted structures using ADV and PIV.

### **Graduate Teaching Assistant**

*August 2002-May 2008*

#### **College of Engineering, The University of Iowa, USA**

53:071: Principles of Hydraulics (*junior level*)

- Prepared and instructed laboratory experiments.

59:005: Engineering Problem Solving I (*freshman level*)

57:020: Mechanics of Fluids and Transfer Processes (*freshman level*)

57:174: Water Resources Design (*senior level*)

57:009: Thermodynamics (*freshman level*)

## Publications:

### **Peer Reviewed Journal Articles**

- Mirocha, J., **Kirkil, G.**, and Bou-Zeid, E., Chow, F. K. and Kosovic, B. (2011) "Transition and Equilibration of Flow Parameters in One-way Nested Large-Eddy Simulations using the Weather Research and Forecasting Model." *Monthly Weather Review*, (submitted).
- **Kirkil, G.**, Mirocha, J. and Bou-Zeid, E., Chow, F. K. and Kosovic, B. (2011) "Implementation and Evaluation of Dynamic Subfilter-scale Models in WRF." *Monthly Weather Review*, doi: 10.1175/MWR-D-11-00037.1
- Constantinescu, G., Miyawaki, S., Rhoads, B., Sukhodolov, A. and **Kirkil, G.** (2010) "The Structure of Turbulent Flow at a River Confluence with a Momentum Ratio Close to One." *Water Resources Research*, 46, W11549, doi: 10.1029/2010WR010018.
- **Kirkil, G.** and Constantinescu, G. (2010) "Flow and Turbulence Structure around an In-stream Rectangular Cylinder with Scour Hole." *Water Resources Research*, 46, W11549, doi: 10.1029/2010WR009336.
- **Kirkil, G.**, Constantinescu, G, Ettema, R. (2009) "Detached Eddy Simulation Investigation of Turbulence at a Circular Pier with Scour Hole." *Journal of Hydraulic Engineering*, 135(11), pp. 888-901. (*This paper has received the 2011 Karl Emil Hilgard Hydraulic Award from American Society of Civil Engineers.*)
- **Kirkil, G.** and Constantinescu, G. (2009) "Nature of Flow and Turbulence around an In-stream Vertical Plate in a Shallow Channel and Implications for Sediment Transport." *Water Resources Research*, 45, W06412, doi: 10.1029/2008WR007363.
- Ettema, R., **Kirkil, G.** and Daly, S. (2008) "Frazil Ice Concerns for Channels, Pump-lines, Penstocks, Siphons and Tunnels in Mountainous Regions." *Cold Regions Science and Technology*, 55 (2), pp. 202-211.
- **Kirkil, G.**, Constantinescu, G, Ettema, R. (2008) "Coherent Structures in the Flow Field around a Circular Cylinder with Scour Hole." *Journal of Hydraulic Engineering*, 134 (5), pp. 572-587.
- Ettema, R., **Kirkil, G.**, Muste, M. (2006) "Similitude of Large-Scale Turbulence in Experiments on Local Scour at Cylinders." *Journal of Hydraulic Engineering*, 132 (1), pp. 33-41.

### **Peer Reviewed Journal Articles in preparation**

- **Kirkil, G.** and Constantinescu, G. (2011) "The Laminar Necklace Vortex System and Wake Structure in a Shallow Channel Flow Past a Bottom Mounted Circular Cylinder." *Physics of Fluids*, (manuscript in preparation).

- **Kirkil, G.,** Lin, C-L. (2011) "Large Eddy Simulations of Wind Flow over Oklahoma City." (manuscript in preparation).
- **Kirkil, G.** and Constantinescu, G. (2011) "Investigation of Turbulent Horseshoe Vortex System around a Circular Cylinder on Flat Bed using Large Eddy Simulation." *Journal of Fluid Mechanics*, (manuscript in preparation).

### Peer Reviewed Conference Proceedings

- Mirocha, J. and **Kirkil, G.** (2010) "Nested high-resolution mesoscale/large eddy simulations in WRF: challenges and opportunities." Proc. The Fifth Int. Symposium on Computational Wind Engineering, Chapel Hill, May 2010.
- **Kirkil, G.** and Constantinescu, G. (2009). "Mean Flow and Coherent Structures in a Shallow Mixing Layer Developing Between Parallel Streams." Proc. 33<sup>rd</sup> IAHR Congress, Vancouver, August 2009.
- **Kirkil, G.** and Constantinescu, G. (2008). "Influence of Large Scale Bed Roughness on the Development of Shallow Mixing Layers." Proc. The Second International Symposium on Shallow Flows, Hong Kong, December 2008.
- **Kirkil, G.** and Constantinescu, G. (2008). "On the Coupling between the Horseshoe Vortex System and the Wake in a Shallow Flow past a bottom-mounted Cylinder." Proc. The Second International Symposium on Shallow Flows, Hong Kong, December 2008.
- **Kirkil, G.** and Constantinescu, G. (2007). "A Comparison of Horseshoe Vortex System at a Circular Bridge Pier between Initial and Final Stages of Scouring Process." Proc. The Fifth International Symposium on Environmental Hydraulics, Tempe, Arizona, December 2007.
- **Kirkil, G.** (2007). "Interaction of Horseshoe Vortex, Detached Shear Layers and Near-Wall Turbulence during Scour at a Bridge Pier." Proc. International Conference on Civil and Environmental Engineering, Higashi-Hiroshima, Japan, October 2007.
- Koken, M., **Kirkil, G.** and Constantinescu, G. (2007). "Coherent Structures in the Flow around a Bridge Abutment and a Bridge Pier at Equilibrium Scour Conditions." Proc. XXXII IAHR Congress, Venice, Italy, July 2007.
- Ettema, R. and **Kirkil G.** (2007) "Frazil Ice Concerns for Channels, Pump Lines, Penstocks, Siphons, and Tunnels in Mountainous Regions." Proc. 14<sup>th</sup> Workshop on the Hydraulics of Ice Covered Rivers, Quebec City, Canada, June 2007
- **Kirkil, G.,** Constantinescu, G. and Ettema, R. (2006). "On the Coupling among the Bed, Detached Shear Layers and Horseshoe Vortex System in the Flow around a Bridge Pier." Proc. 3<sup>rd</sup> International Conference on Scour and Erosion, Amsterdam, Netherlands, November 2006.
- Ettema R., **Kirkil, G.** (2006). "Vorticity Similitude in Experiments on Local Scour." Proc. XXII Latin American Congress on Hydraulics, Venezuela, October 2006.
- **Kirkil, G.,** Constantinescu, G. and Ettema, R. (2006). "Investigation of the Velocity and Pressure Fluctuations Distributions inside the Turbulent Horseshoe Vortex System around a Circular Bridge Pier." Proc. International Conference on Fluvial Hydraulics, Lizbon, Portugal, September 2006.

- **Kirkil, G.,** Constantinescu, G. and Ettema, R. (2005). "The Horseshoe Vortex System around a Circular Bridge Pier on Flat Bed." Proc. XXXI IAHR Congress, Seoul, Korea, September 2005.
- **Kirkil, G.,** Constantinescu, G. and Ettema, R. (2005). "The Horseshoe Vortex System around a Circular Bridge Pier on Equilibrium Scour Bed." World Water and Environmental Resources Congress, Alaska, USA, May 2005.
- **Kirkil, G.,** Ettema, R. and Muste, M. (2004). "Similitude of Coherent Turbulence Structures in Flume Studies of Bridge Scour." Proc. 2<sup>nd</sup> International Conference on Scour and Erosion, Singapore, November 2004.

### **Presentations**

- **Kirkil, G.** and Mirocha, J. (2010). "Assessing the performance of the WRF model's large eddy simulation capability in nested-domain simulations." 19<sup>th</sup> Symposium on Boundary Layer and Turbulence, Keystone, August 2010.
- **Kirkil, G.** and Mirocha, J. (2010). "Nested high-resolution mesoscale/large eddy simulations in WRF: challenges and opportunities." The Fifth Int. Symposium on Computational Wind Engineering, Chapel Hill, May 2010.
- **Kirkil, G.** and Mirocha, J. (2009). "Implementation of Dynamic Eddy Viscosity Subfilter Turbulence Model in WRF" 10<sup>th</sup> WRF User's Workshop poster presentation, National Center for Atmospheric Research.
- **Kirkil, G.** and Constantinescu, G. (2007). "LES Investigations of Flow around a Cylinder on Flat and Equilibrium Scour Beds" 5<sup>th</sup> Annual Research Open House poster presentation, College of Engineering, The University of Iowa.
- **Kirkil, G.,** Constantinescu, G. and Ettema, R. (2005). "Investigation of Flow around a Bridge Pier on Equilibrium Scour Bed using LES." 3<sup>rd</sup> Annual Research Open House poster presentation, College of Engineering, The University of Iowa.
- **Kirkil, G.,** Ettema, R. and Muste, M. (2004). "Investigation of Scale Effects in Bridge Pier Scour Equations Using ADV and LSPIV." 2<sup>nd</sup> Annual Research Open House poster presentation, College of Engineering, The University of Iowa.

### Computer Skills:

#### **CFD software:**

Stanford-CTR's CDP (LES code using unstructured grids), IIHR's Parallel 3D (DES/URANS/RANS code with particulate transport capabilities), IIHR's Parallel Finite Element LES solver, WRF-ARW code, FLUENT, CFX, COMSOL, MIKE 21

#### **Grid generation software:**

Gridgen, Gambit

#### **Programming languages:**

Fortran 77&90, C++, MPI, OpenMP, Matlab, IDL

**CAD and visualization packages;**

AutoCAD, Tecplot, Adobe Photoshop, Adobe Premiere, LSPIV 5.0, Horizon ADV

**Awards and Honors:**

- ASCE Karl Emil Hilgard Hydraulic Award (2011)
- Hiroshima University & IIHR Travel Fund Award (2007)
- Arizona State University & NSF Travel Fund Award (2007)
- The University of Iowa Graduate Student Senate (GSS) Travel Fund Award (2007)
- The University of Iowa Center for Global and Regional Research (CGRER) Travel Fund Award (2007)
- Certificate, Web-based Collaborative Engineering in Hydroscience, IAHR (2003).
- Scholarship from Turkish Education Foundation (2000-2002).
- Honorable Mention Student Paper, 16<sup>th</sup> Turkish Civil Engineering Technical Congress, Turkey (2001).

**Professional Affiliations:**

- Member, International Association of Hydraulic Research (IAHR)
- Member, American Society of Civil Engineers (ASCE)
- Member, American Geophysical Union (AGU)
- Member, American Meteorological Society (AMS)

**Other Activities:**

- Reviewer, Journal of Applied Mathematics (2011- )
- Reviewer, European Journal of Mechanics B / Fluids (2011- )
- Reviewer, Journal of Hydraulic Research (2009- )
- President, IAHR Iowa Student Chapter (2007)
- President, Students of IIHR (2007)