Aerospace Engineering

AE 598  **Special Topics**  credit: 1 TO 4 hours.

Subject offerings of new and developing areas of knowledge in aerospace engineering intended to augment existing formal courses. Topics and prerequisites vary for each section. See Class Schedule or departmental course information for both. May be repeated in the same or separate terms if topics vary to a maximum of 12 hours.

<table>
<thead>
<tr>
<th>CRN</th>
<th>Type</th>
<th>Section</th>
<th>Time</th>
<th>Days</th>
<th>Location</th>
<th>Instructor</th>
</tr>
</thead>
<tbody>
<tr>
<td>69433</td>
<td>Online</td>
<td>ONL</td>
<td>ARRANGED -</td>
<td>-</td>
<td>-</td>
<td>Freund, J</td>
</tr>
</tbody>
</table>

Credit Hours: 4 hours

Uncertainty Quantification

Restricted to MS: Civil Engr - Online - UIUC, MCS:Computer Sci Online -UIUC, MS:Mechanical Engineering -UIUC, MS: Aerospace Engr-Online-UIUC, NDEG:Grad Nondegree-CE-UIUC, or MENG:Mech Engineering Onl-UIUC.

Title: Simulation prediction with quantified uncertainty Advances in computational techniques and resources have made predictive simulations an indispensable tool across engineering and science, with integration of continually more physical models into simulation tools to represent increasingly complex phenomena. This increases the challenge of both validating and quantifying the predictive uncertainty of such simulations. For true predictions there is no corresponding experimental data to check against, so quantification of predictive uncertainty increases their utility and can target pacing sources of uncertainty for reduction. This course will introduce technique for quantifying the uncertainty of simulation predictions. After the predictive science challenge is introduced and motivated with examples, we will: review basic statistical tools and distributions; discuss probability as measures of belief; examine the strengths, limitations, and design of experiments for calibration and validation; introduce quantitative model selection and hypothesis testing for the design and evaluation of physical models; and present methods to propagate known uncertainties through a predictive simulation to the quantity of interest. Inverse adjoint-based sensitivity methods will be discussed for use in validation and uncertainty quantification. Mechanics based examples will be used throughout for motivation. Prerequisites: experience in (1) numerical methods (minimally TAM470, AE370 or equivalent), (2) mathematics (TAM541/2 or equivalent), and (3) experience with fluid and/or solid mechanics. Restricted to online non-degree, online, MSAE, online MSME, online MSCEE and online MCS students. For more details on this course section, please see http://engineering.illinois.edu/online/courses/. Non-Degree students may enroll on a space-available basis with consent of Program Coordinator, Staci Tankersley (tank@illinois.edu).

| 69432 | Online     | OUA     | ARRANGED -   | -    | -          | Ansell, P  |

Credit Hours: 4 hours

Unsteady Aerodynamics

Restricted to MS: Civil Engr - Online - UIUC, MCS:Computer Sci Online -UIUC, MS:Mechanical Engineering -UIUC, MS: Aerospace Engr-Online-UIUC, NDEG:Grad Nondegree-CE-UIUC, or MENG:Mech Engineering Onl-UIUC.

Principles of viscous unsteady flows, unsteady airfoil behavior through gusts, pitching, and plunging motions; inviscid modeling approaches, and semi-empirical methods. Restricted to online non-degree, online, MSAE, online MSME, online MSCEE and online MCS students. For more details on this course section, please see http://engineering.illinois.edu/online/courses/. Non-Degree students may enroll on a space-available basis with consent of Program Coordinator, Staci Tankersley (tank@illinois.edu).

| 68453 | Lecture-Discussion | UA     | 03:30 PM - 04:50 PM | TR    | 410C1 - Engineering Hall | Ansell, P  |

Credit Hours: 4 hours

Unsteady Aerodynamics

Principles of viscous unsteady flows, unsteady airfoil behavior through gusts, pitching, and plunging motions; inviscid modeling approaches, and semi-empirical methods.

| 65309 | Lecture-Discussion | UQ     | 09:00 AM - 09:50 AM | MWF   | 410C1 - Engineering Hall | Freund, J  |

Credit Hours: 4 hours

Uncertainty Quantification
Title: Simulation prediction with quantified uncertainty Advances in computational techniques and resources have made predictive simulations an indispensable tool across engineering and science, with integration of continually more physical models into simulation tools to represent increasingly complex phenomena. This increases the challenge of both validating and quantifying the predictive uncertainty of such simulations. For true predictions there is no corresponding experimental data to check against, so quantification of predictive uncertainty increases their utility and can target pacing sources of uncertainty for reduction. This course will introduce technique for quantifying the uncertainty of simulation predictions. After the predictive science challenge is introduced and motivated with examples, we will: review basic statistical tools and distributions; discuss probability as measures of belief; examine the strengths, limitations, and design of experiments for calibration and validation; introduce quantitative model selection and hypothesis testing for the design and evaluation of physical models; and present methods to propagate known uncertainties through a predictive simulation to the quantity of interest. Inverse adjoint-based sensitivity methods will be discussed for use in validation and uncertainty quantification. Mechanics based examples will be used throughout for motivation. Prerequisites: experience in (1) numerical methods (minimally TAM470, AE370 or equivalent), (2) mathematics (TAM541/2 or equivalent), and (3) experience with fluid and/or solid mechanics.