Prescheduled topics for workshop and panel discussion
105.5.30-105.6.1 by Reed Chang
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Workshop topics

1. Instruction of advanced technologies for high thrust turbofan engines performing component aerodynamic design, analysis and testing
2. Provision of design methodologies, tools and practices application for turbofan engine component design and analysis
3. Study of how to overcome difficulties and problems possibly encountered during the component aerodynamic design phase of turbofan engines
4. Analysis of stage matching and off-design performance of multistage axial-flow compressors
5. Research on the cooling system design and analysis of turbines
6. Design research for shock free supersonic compressor and turbine blades
7. Discussion on the design of turbochargers and the principles of turbocharging matching with internal combustion engines

Panel discussion topics

Turbomachinery Aerodynamics

1. Do we have to do the geometry transformation of turbine blades and vanes of cold and hot conditions? If yes, how can we do that?
2. What are the concepts and key points to designing the variable vanes of compressor? Do we need to do the off design performance analysis prior to the design of variable vanes?
3. How to reduce shock intensity inside the compressor and the turbine?
4. Generally speaking, does the vane stacking of turbine differ from that of blade stacking, and what are the criteria in the determination of stacking axis?
5. Are forward swept and back swept or leaned fan designs applied to the contemporary turbine engines? What’s the effect of blade sweep and lean on fan performance?
6. What are the benefits to the fan designed with a low hub to tip ratio?
7. How to enhance the prediction accuracy of static thrust of propellers by CFD method?
Engine Performance

8. How to construct a dynamic simulation of an engine applied to the performance analysis and control strategy simulation during acceleration and deceleration transients of the engine?

9. To build a derivative engine by scaling up existing engines, what are the scaling limits and what critical factors should be considered referring to component design and testing in terms of capability, cost and risk?

10. Could you provide the information required to create an engine numerical simulation concurrently incorporating the setup of material processing, structure design, manufacture process as considered as those on real engines besides performance in order to reduce the test cycle time.

Engine Design

11. What is the development trend of engine layout based on the comparison of TFE1042 and F404 engine layout?

12. What are the critical concepts in designing the mixers and variable nozzles?

Combustor Design

13. How to verify and avoid the phenomenon of combustion instability whether which will affect the efficiency of an engine or not?

14. How to enhance the prediction accuracy of flame location, flame temperature and liner wall temperatures by CFD method?

15. To predict the secondary flows and the cooling performance of turbines, which of Flowmaster and Flownex has the higher accuracy?

16. Currently, the technical report of GE reveals that the trapped vortex combustor, TVC, will be the development trends of combustors. Could you please provide us with the TVC design information?

17. The film cooling of liner wall is a key factor to combustor design in conventional gas turbine engine. Is there novel technology of material, design and manufacture for us to enhance the software of combustor preliminary design?

18. The evaporator tube fuel nozzle, used on turbine engines in France, is of simple structure and easy fabrication. Are there any limitations of designing and using the evaporator tube fuel nozzle?

Cooling Design

19. How to simplify cyclic structural analysis of hollow turbine blades? Are there any
software published for analysis and model construction?

20. Could we design turbine blade cooling channels by numerical simulation approach without taking reference to existing turbine blade cooling?

21. The technologies of design, material processing, and manufacture process of hot section of the engine dominate the engine development. Is it possible to introduce the technologies of hot section of the engine to promote domestic engine development?

**Engine Testing**

22. Please provide the information about dynamic and indirect measurement techniques, and for which recommend corporations able to assist us in establishing the capabilities.

23. What technology is most currently used in the engine condition monitoring and fault diagnosis?

24. In addition to big data analytics and neural network analysis, does it help if we incorporate with the failure mode and effects analysis (FMEA) on the engine test and fault diagnosis system?

25. Please recommend guidelines of the ASRD’s engine test facility and instrumentation?

26. How to promote the capability of test facility for developing a high thrust engine, say, 30000lbf, based on that originally constructed for the test of medium or lower thrust engines? Additionally, please recommend corporations suitable for the promotion program of test facility through international cooperation.

**Engine Manufacturing**

27. Is it feasible to manufacture engine parts using 3D printing techniques? Are there any successful applications?

28. What engine components and parts to which nanotechnology can be applied and to what extend the engine performance will be enhanced if we use nanotechnology?

29. Could you help us find suitable manufacturers of titanium alloy casting and forging for aeronautics in the US?

30. Could you provide the information referring to engine accessory manufactures and related manufacturers?

**Structural analysis**

31. How to estimate the blade skin temperature of turbines?

32. How to predict the fatigue lives for HCF and LCF for a rotating rotor subjected to
centrifugal forces, aerodynamic forces and high temperature?

33. What key factors related to design and stress analysis need to be taken into account when installing rotor blades by inserting dovetails or fir trees into disk grooves?

**Engine control**

34. What are the trends and methodologies for turbine engine control system development?

35. Could you provide us with information for ECU system referring to the software development, design specification, software verification and validation and the testing of control system, etc.?
Prescheduled topics for workshop and panel discussion

Workshop topics

1. Instruction of advanced technologies for high thrust turbofan engines performing component aerodynamic design, analysis and testing
   請指導高推力渦輪扇引擎組件氣動力設計、分析及試驗相關技術
2. Provision of design methodologies, tools and practices application for turbofan engine component design and analysis
   請提供渦輪扇引擎各組件設計分析方法、分析工具及應用實例
3. Study of how to overcome difficulties and problems possibly encountered during the component aerodynamic design phase of turbofan engines
   渦輪扇引擎組件氣動力設計待克服的問題探討
4. Analysis of stage matching and off-design performance of multistage axial-flow compressors
   多級壓縮器之各級匹配設計及性能分析
5. Research on the cooling system design and analysis of turbines
   渦輪冷卻設計及分析研究
6. Design research for shock free supersonic compressor and turbine blades
   抗震波超音速壓縮器及渦輪葉片設計研究
7. Discussion on the design of turbochargers and the principles of turbocharging matching with internal combustion engines
   渦輪增壓器設計及其與內燃機的匹配原理討論

Panel discussion topics

Turbomachinery Aerodynamics

1. Do we have to do the geometry transformation of turbine blades and vanes of cold and hot conditions? If yes, how can we do that?
   渦輪葉片在冷熱不同狀態下必須進行外形轉換嗎? 如需要，如何轉換?
2. What are the concepts and key points to designing the variable vanes of compressor? Do we need to do the off design performance analysis prior to the design of variable vanes?
   壓縮器可變葉片設計之關鍵概念為何？在設計之前必須先進行性能分析嗎？
3. How to reduce shock intensity inside the compressor and the turbine?

如何降低壓縮器及渦輪之震波強度?

4. Generally speaking, does the vane stacking of turbine differ from that of blade stacking, and what are the criteria in the determination of stacking axis?

一般而言，渦輪之靜子和轉子之葉切面疊合有何不同？疊合軸如何決定？

5. Are forward swept and back swept or leaned fan designs applied to the contemporary turbine engines? What’s the effect of blade sweep and lean on fan performance?

當代主流發動機有無前後掠或前後傾之扇設計？其對扇性能有何影響？

6. What are the benefits to the fan designed with a low hub to tip ratio?

低輪轂比的扇有何優勢？

7. How to enhance the prediction accuracy of static thrust of propellers by CFD method?

請問利用數值模擬，如何提高螺槳靜推力預估的準確度？

**Engine Performance**

8. How to construct a dynamic simulation of an engine applied to the performance analysis and control strategy simulation during acceleration and deceleration transients of the engine?

如何建立引擎動態模擬系統，以應用於引擎加減速暫態過程之性能分析及控制策略模擬？

9. To build a derivative engine by scaling up existing engines, what are the scaling limits and what critical factors should be considered referring to component design and testing in terms of capability, cost and risk?

以比例縮放現有引擎之衍生型引擎設計，其縮放比例限制為何？在引擎設計能力、成本及風險衡量下，要考慮那些重要因素

10. Could you provide the information required to create an engine numerical simulation concurrently incorporating the setup of material processing, structure design, manufacture process as considered as those on real engines besides performance in order to reduce the test cycle time.

如何建立一個考慮材料、結構、性能及製造等引擎數值模式，以便未來能減少引擎測試次數。

**Engine Design**

11. What is the development trend of engine layout based on the comparison of TFE1042 and F404 engine layout?
比較 TFE1042 與 F404 引擎架構之優缺點，並據以說明引擎架構之發展趨勢為何。

12. What are the critical concepts in designing the mixers and variable nozzles?
可變噴嘴及混合器之主要設計概念為何?

**Combustor Design**

13. How to verify and avoid the phenomenon of combustion instability whether which will affect the efficiency of an engine or not?
燃燒不穩定性如何影響引擎性能，如何確認並預防。

14. How to enhance the prediction accuracy of flame location, flame temperature and liner wall temperatures by CFD method?
請問利用數值模擬方法，如何提高火焰位置、火焰溫度及襯筒壁面溫度預測的準確度?

15. To predict the secondary flows and the cooling performance of turbines, which of Flowmaster and Flownex has the higher accuracy?
請問 Flowmaster 及 flownex 應用於引擎二次流或渦輪冷卻預測，何者準確度較高?

16. Currently, the technical report of GE reveals that the trapped vortex combustor, TVC, will be the development trends of combustors. Could you please provide us with the TVC design information?
由奇異(GE)公司的技術報告顯示，渦漩駐焰燃燒室(Trapped Vortex Combustor, TVC)為未來燃燒室的研發方向，能否提供相關設計資訊。

17. The film cooling of liner wall is a key factor to combustor design in conventional gas turbine engine. Is there novel technology of material, design and manufacture for us to enhance the software of combustor preliminary design?
燃燒室襯筒壁面薄膜冷卻(film cooling)技術為傳統渦輪引擎燃燒室的重要設計要素。目前在材料、設計或製造上是否有更新的方法或技術可應用於燃燒室初步設計程式的精進?

18. The evaporator tube fuel nozzle, used on turbine engines in France, is of simple structure and easy fabrication. Are there any limitations of designing and using the evaporator tube fuel nozzle?
使用於法國渦輪引擎蒸發式(evaporator tube)燃油噴嘴，其構造簡單易於製造，請問教授此噴嘴於設計及使用上有何限制?

**Cooling Design**

19. How to simplify cyclic structural analysis of hollow turbine blades? Are there any software published for analysis and model construction?
如何簡化空心渦輪葉片結構分析，是否有合適的分析及模式建立軟體?

20. Could we design turbine blade cooling channels by numerical simulation approach without taking reference to existing turbine blade cooling?

在沒有可參考的渦輪冷卻系統下，是否可利用數值模擬設計渦輪冷卻流程?

21. The technologies of design, material processing, and manufacture process of hot section of the engine dominate the engine development. Is it possible to introduce the technologies of hot section of the engine to promote domestic engine development?

由於引擎熱段的設計、材料及製程技術為引擎發展之關鍵性技術。是否能由國外相關的公司或學校在提供引擎熱段研製技術，以提升國內引擎研發水準。

Engine Testing

22. Please provide the information about dynamic and indirect measurement techniques, and for which recommend corporations able to assist us in establishing the capabilities.

請提供動態量測及間接量測技術以及可協助建立這方面能量的廠商。

23. What technology is most currently used in the engine condition monitoring and fault diagnosis?

目前引擎狀態診斷之最新科技為何?

24. In addition to big data analytics and neural network analysis, does it help if we incorporate with the failure mode and effects analysis (FMEA) on the engine test and fault diagnosis system?

引擎試驗及失效診斷，除了利用大數據及類神經網路分析之外，是否可再加入失效模式分析?

25. Please recommend guidelines of the ASRD’s engine test facility and instrumentation?

對本所引擎試驗設備及儀電之建議。

26. How to promote the capability of test facility for developing a high thrust engine, say, 30000lbf, based on that originally constructed for the test of medium or lower thrust engines? Additionally, please recommend corporations suitable for the promotion program of test facility through international cooperation.

如何將原使用於中低推力引擎試驗之設備擴充適用於高推力引擎，例如 30000 磅引擎之試驗設備？國外是否有合適廠商可參與合作？

Engine Manufacturing

27. Is it feasible to manufacture engine parts using 3D printing techniques? Are there any successful applications?
How to apply 3D printing to engine component manufacturing? Are there any successful cases?

28. What engine components and parts to which nanotechnology can be applied and to what extent the engine performance will be enhanced if we use nanotechnology?

Nanotechnology can be applied to engine components, and its effect on engine performance will be enhanced.

29. Could you help us find suitable manufacturers of titanium alloy casting and forging for aeronautics in the US?

We can recommend suitable manufacturers in the US.

30. Could you provide the information referring to engine accessory manufacturers and related manufacturers?

We can provide the necessary information.

Structural analysis

31. How to estimate the blade skin temperature of turbines?

Blade skin temperature of turbines can be estimated.

32. How to predict the fatigue lives for HCF and LCF for a rotating rotor subjected to centrifugal forces, aerodynamic forces and high temperature?

Fatigue life predictions for HCF and LCF can be made.

33. What key factors related to design and stress analysis need to be taken into account when installing rotor blades by inserting dovetails or fir trees into disk grooves?

Factors related to design and stress analysis need to be considered.

Engine control

34. What are the trends and methodologies for turbine engine control system development?

Current trends and methodologies for turbine engine control system development are discussed.

35. Could you provide us with information for ECU system referring to the software development, design specification, software verification and validation and the testing of control system, etc.?

We can provide the necessary information for ECU system development.