Current Laminar Flow Control Experiments at NASA Dryden

Experimental Soaring Association

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Laminar Flow

• Decades of research
• Increase the amount of low-drag boundary-layer laminar flow over the wings
• Possible savings of 10-15% in total aircraft drag (more with optimization?)
Experiment Background

- ~13 billion gallons of aviation fuel per year
- Laminar flow = substantial fuel savings
- Swept wings above Mach 0.6
- Crossflow transition
- Traditional answer = suction
Discrete Roughness Elements

• Swept wings are strongly crossflow dominated
• Discrete Roughtness Elements show the ability to stabilize the laminar boundary layer
• Subcritical frequency wave in the boundary layer is stabilizing
• Research sponsored by NASA Environmentally Responsible Aviation Project (Dr Fay Collier)
Discrete Roughness Elements
Current State of the Art

- Texas A&M (Saric & Reed)
- Air Force Research Labs (Flick & Dale)
Swept Wing In-Flight Test
SWIFT Experiment

without DRE

18.7°C

with DRE

18.3°C
TAMU SWIFT Success

- 30 deg leading edge wing sweep
- Up to 8 million chord Reynolds number
- Up to 60% laminar flow with DRE
  - Laminar flow region was doubled
NASA Gulfstream III

- G III good representative “small” airliner
- Big wing (chord between 737 & 757)
Experiment Design

- Passive Laminar Flow w/ DRE
- 1/ get the best experiment possible (Bill Saric & Helen Reed @ Texas A&M)
- 2/ base the next step on previous work (SWIFT experiment by TAMU/AFRL)
- 3/ be ambitious and go for full cruise envelope of medium airliner (M 0.75, CL 0.3, & Re 20M)
TAMU Airfoil & Glove
Add-on Experiment

- Active Compliant Trailing Edge Flap (AFRL & FlexSys)
Concluding Remarks

• Passive laminar flow control using Discrete Roughness Elements
• Texas A&M and Air Force Research Labs teamed with NASA
• Push for full cruise envelope of a medium size airliner
• Continuous moldline flap experiment
Questions?