User Group 2007

Part 5B: Origin Based Assignments

Friday 19th October 2007

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SATURN Origin Based Assignments

Outline

- **What is OBA?**
- **Advantages and Disadvantages: OBA versus Frank Wolfe**
- **History in SATURN**
- **Examples**
- **Limitations & Future Work**

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What is OBA?

- **Origin-Base Assignment**
  - An Algorithm developed by Dr Hillel Bar-Gera
  - A Ph.D student work with Professor Dave Boyce, University of Illinois at Chicago in the late1990s
  - A major breakthrough in both theory and practice for equilibrium traffic assignment
- **Mathematical Properties**
  - Wardrop equilibrium solution is guaranteed
  - Restriction to solutions that are a-cyclic by origin
  - Store link flows by origin
  - Effective in eliminating residual flows

Advantages & Disadvantages: OBA v FW

- **Advantages**
  - Exact solutions to Wardrop Equilibrium Assignment
  - Accurate in assessing small schemes
  - Eliminate “noise” that exists in FW
  - Natural algorithm for Warm Start
  - Exact solutions for standard post-assignment analysis:
    - Trees/Forests/Selected Link Analysis
  - No approximation to previous results
    - Required under FW with default DIDDLE option (ie SAVEIT=T)
- **Disadvantages:**
  - Limited only by the numerical accuracy of computers
  - Uses more memory as route flows are stored

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History of SATURN-OBA

- **Single User Class (SUC OBA)**
  - First available in SATURN 10.5
  - Through a collaboration with Hillel Bar-Gera and the University of Chicago
  - Available as an add-on module (£2,250 to £3,500)

- **Multiple User Class (MUC OBA)**
  - An extended version of Hillel Bar-Gera's SUC OBA
  - Implemented by Dr Yanling Xiang, Atkins (2006)

- **SUC/MUC OBA in SATURN**
  - MET = 2 (Default: MET=0 for FW)
  - AUTOK introduced by DVV
  - Currently under Beta testing (Sept 2007)
  - Full release as part of SATURN v10.8
  - Cost = SUC + TBC

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Example 1 - SUC

- A small buffer-only network of Headingley (29 zones)
- A small *scheme*: add a single pcu/hr to a particular OD
- Convergence criteria: NITA=199, ISTOP=100, PCNEAR=0.2%, NISTOP=4
- Noise made FW results incomprehensible

	Frank-Wolfe		O B A	
	Before	**After**	**Before**	**After**
PCU-hrs	443.14	442.99	442.45	442.84
Delta %	0.149	0.111	0.0001	0.0001
Iterations	199	199	30	32
CPU (secs)	0.8	0.8	0.4	0.4

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Example 2 - MUC

- A real-life combined simulation and buffer network (362 zones)
- Convergence criteria: NITA=10,NISTOP=4 (for example)
- MUC OBA takes longer to achieve the same level of Gap%

	Frank-Wolfe	Frank-Wolfe	MUC OBA
ISTOP/PCNEAR	95/5%	100/0.2%	95/5%
PCU-hrs	64354	64279	64274
Delta (%)	0.250	0.061	0.002
Gap (%)	0.240	0.054	0.054
Loops	14	174	8
CPU (secs)	90	274	658

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Example 3 - MUC

- A real-life combined simulation and buffer network (215 zones)
- Convergence criteria: NITA=10, *PCNEAR=0.5%*,NISTOP=4,ISTOP=99
- MUC OBA takes longer time to achieve better convergence with %Gap and %Delta

	Frank-Wolfe	MUC OBA
Loops (MASL)	40	40
PCU-hrs	44347	44323
%FLOWS	88%	98%
Delta (%)	0.0328	0.0002
Gap (%)	0.039	0.0086
CPU (secs)	84	546

Recommendations

- Clear NAFF errors (WRIGHT=T)
  - In any case!
- Use AUTOK to dampen oscillations (as with FW)
- Use KONSTP and STPGAP=1 (%Gap) as the convergence criteria for DIADEM runs
- Use WARM START whenever possible for OBA
- If failed to reach convergence:
  - check the .LPT file especially the 10 *Worst Converged Nodes*
  - Revise the simulation network coding
  - Check some more!

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Next Development Steps

- **Memory Management - "out of memory"**
  - Revised file input / output routines to reduce internal memory usage
- **Run Times – "longer than FW"**
  - Optimise internal looping structure
  - Warm Start with FW then switch to OBA
  - Implement standard parallel mechanisms to reduce run times
- **Secondary Analysis**
  - Further checks on secondary analysis procedures
- **Feedback from Users**
  - More testing

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Part 5B: Questions & Answers

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