Transit Schedule Adherence Using Passive GPS and GIS

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GIS-T 2003
GIS - T: The Evolving Frontier
Colorado Springs, CO
March 17th - 19th

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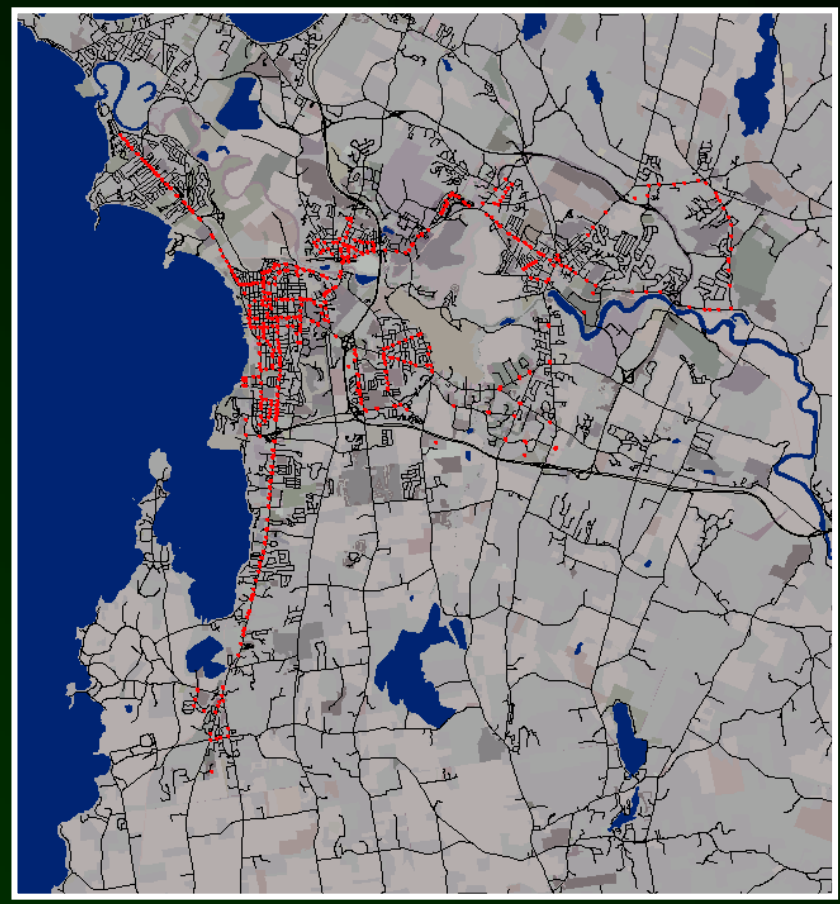
Project Description

- Team with MultiSystems
- CCTA in Burlington, Vt. (ridership of 1.5 million)
- No AVL system
- Single passive GPS logger
- GPS rotated across routes each day for one year
- Schedule adherence evaluation



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General Concept

- Bus carries passive GPS during day
- Logger stores all movement and time
- GIS matches GPS to ‘time point’ and schedule
- Difference in observed vs. scheduled determines adherence

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Existing AVL Limitations

- These capabilities do exist within existing AVL systems, but….

- AVL designed for real-time tracking of fleet operations
- Many do not purchase post-processing analysis programs
- AVL can have high communication costs ($300/veh/day) to record data
- Most small transit agencies cannot justify AVL expense
- Many agencies do not have the personnel to operate AVL systems outside of standard operating procedures.

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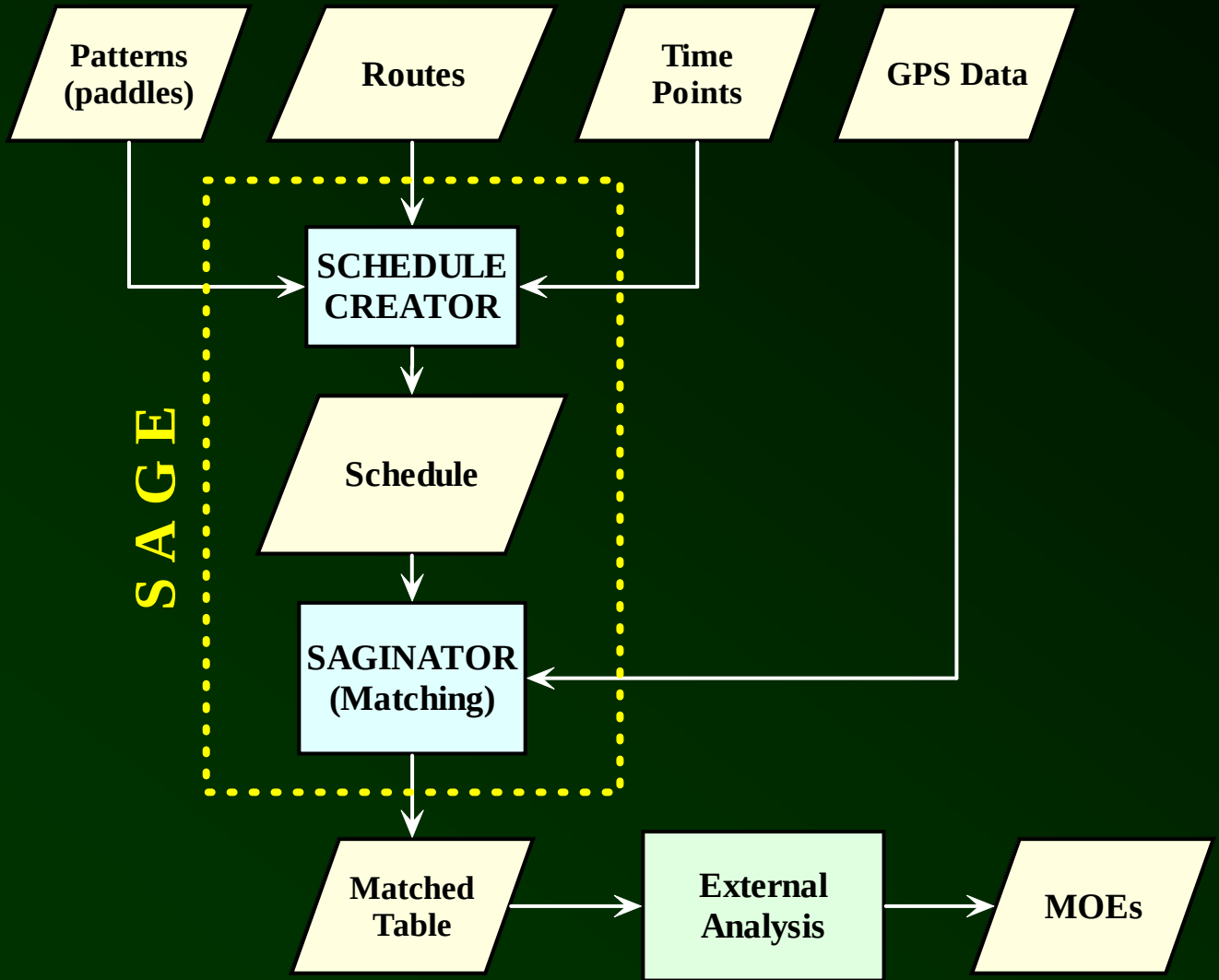
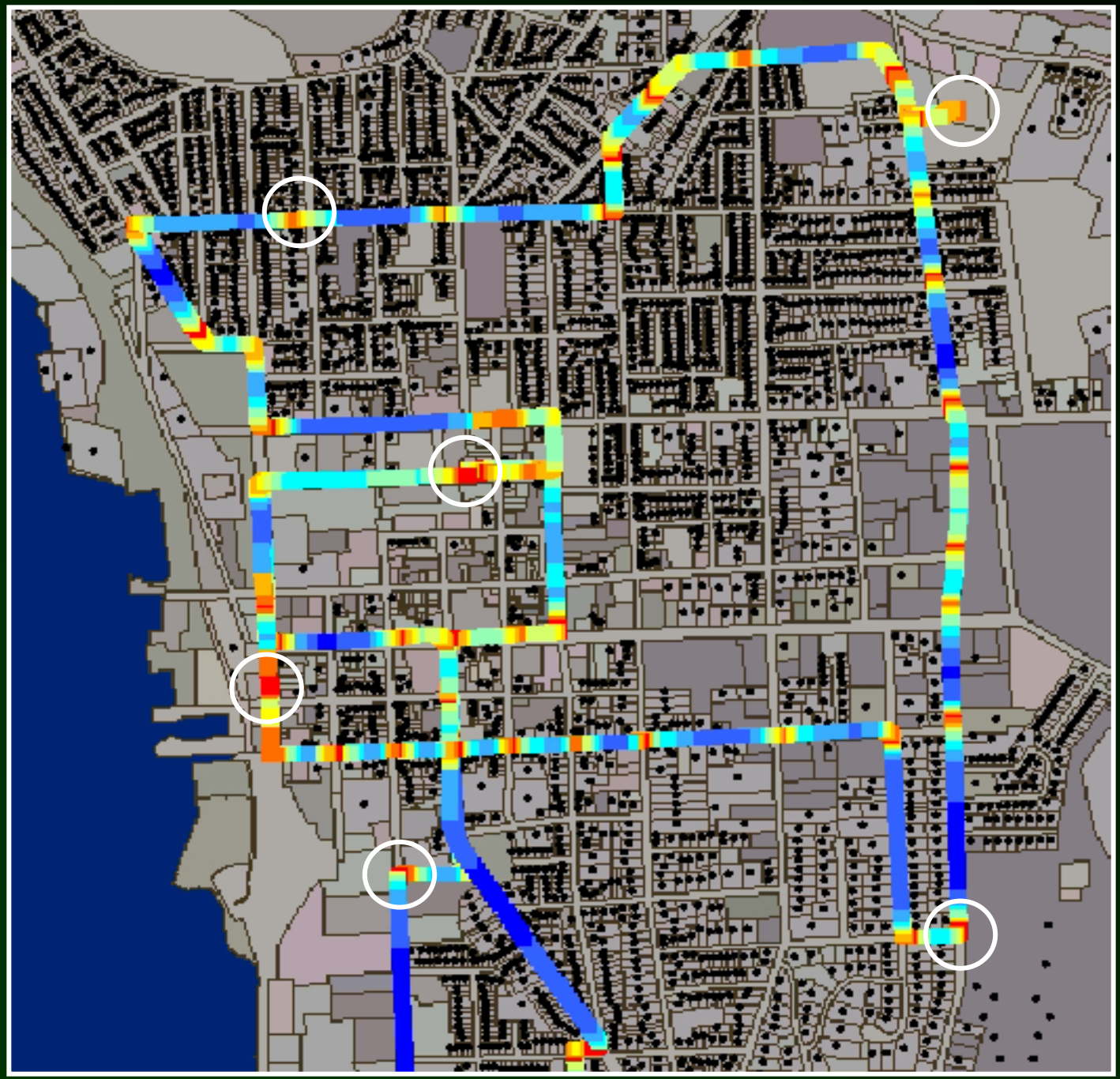
Project Process





GIS-T 2005

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Colorado Springs, CO

March 13th - 16th

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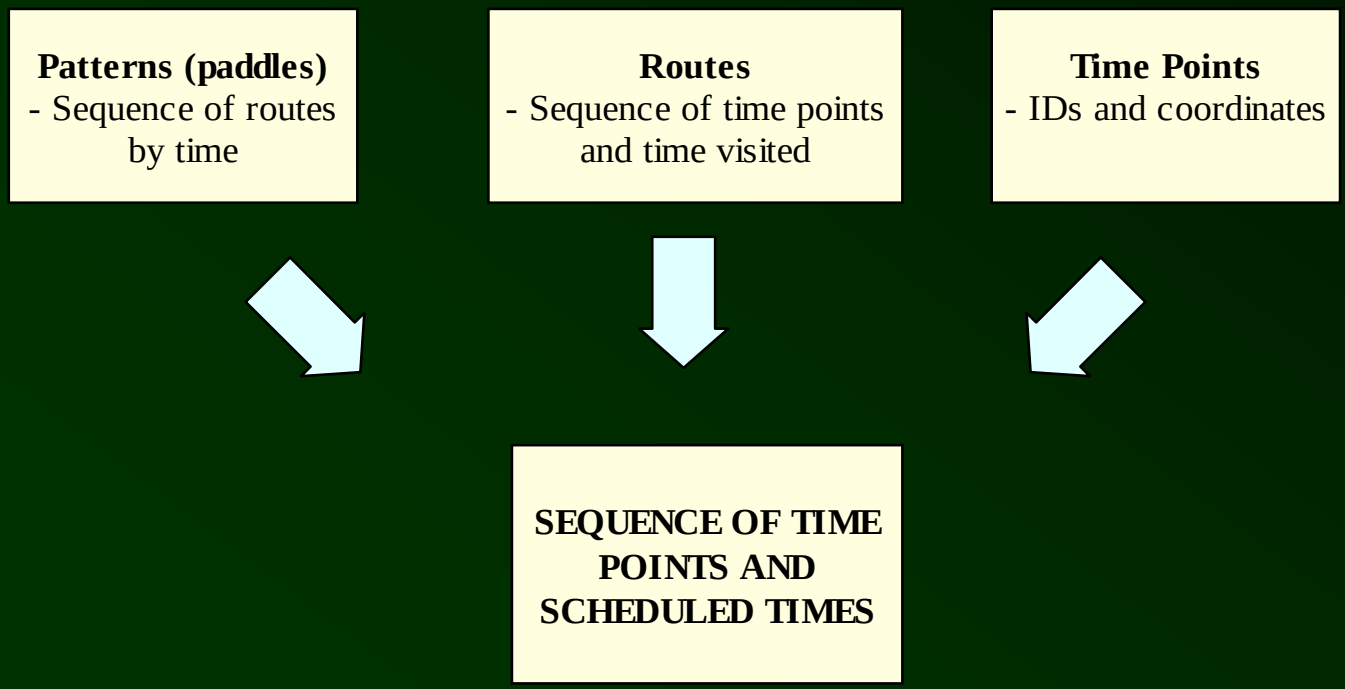
Schedule Data Preparation

Create tables of :

1. Route files with time point and time visited
2. Pattern files with routes and times started
3. Time points with coordinates



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GPS Data Collection

- Generate sampling plan to cover all routes, buses, and drivers
- Put passive GPS on bus at start of day
- Take passive GPS off bus at the end of the day
- Download data to PC, save with bus ID and date

- Passive logger
- Powered via vehicle's cigarette lighter socket
- Logs at 1-second or 5-second frequencies
- Records date, time, lat, long, speed, heading, altitude
- Accuracy levels:
  - Date and time are exact
  - Position is within 5-15m
  - Speed is within 0.5 mph

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S.A.G.E.
Schedule Adherence GIS Engine

- VB and MapObjects application
- Creates sequential time point schedule for bus
- Automated matching process

Bus id	Rte	Dir	Time Point ID	Scheduled Time	Arrival Time	Departure Time	Dwell Time (min:sec)	Arrival Time Diff (min)	Departure Time Diff (min)
A01	1	IB	2	11:00:00	11:00:33	11:00:39	0:06	0.6	0.7
A01	1	IB	1	11:10:00	11:07:24	11:15:07	7:43	-2.6	5.1
A01	5	OB	1	11:15:00	11:07:24	11:15:07	7:43	-7.6	0.1
A01	5	OB	2	11:18:00	11:19:18	11:19:47	0:29	1.3	1.8
A01	5	OB	3	11:22:00	11:24:09	11:24:22	0:13	2.2	2.4
A01	5	IB	4	11:27:00	11:29:57	11:30:11	0:14	3	3.2
A01	5	IB	2	11:37:00	11:36:57	11:37:40	0:43	-0.1	0.7
A01	5	IB	1	11:40:00	11:42:48	11:43:39	0:51	2.8	3.7
A01	8	LP	1	14:45:00	14:21:44	14:46:10	12:26	-23.3	1.2
A01	8	LP	2	14:51:00	14:51:24	14:51:34	0:10	0.4	0.6
A01	8	LP	3	14:55:00	14:54:25	14:54:50	0:25	-0.6	-0.2
A01	8	LP	4	14:58:00	14:58:13	14:58:27	0:14	0.2	0.5
A01	8	LP	5	15:00:00	15:01:05	15:01:21	0:16	1.1	1.4

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Interesting Matching Issues

- Break time behavior
- Last stop before break frequently skipped
- Route deviations
- Pre-stop stops
- Instances where schedule ‘laps’ the bus
- Unscheduled stops

General Results

- 320+ days of bus data
- ~ 10,000,000 seconds of data
- ~ 40,000 scheduled time points
- 99% Success rate in matching to a correctly scheduled time point
- 70% of time point schedules were correct

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CCTA Use of Data

- Reporting went beyond simple schedule adherence due to quality of data
- MS also generated a route report:
  - Scheduled running time
  - Mean observed running time
  - STD of observed running time
  - Highest observed running time
  - Lowest observed running time
  - Number of observations

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Next Steps

- Add route adherence analysis
- Add flexible schedule importing capability
- Add visualization component
- Enhance analysis capabilities
  - Route analysis
  - Congested facilities analysis
  - Driver performance (ie., speed in residential zones)
- Provide flexible report generator

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