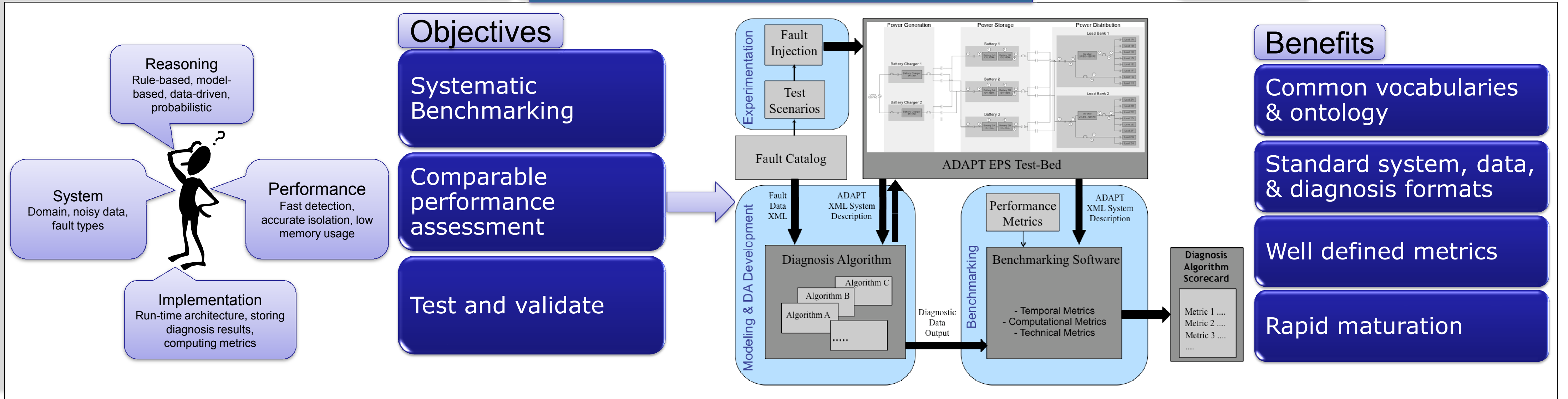


Benchmarking Diagnostic Algorithms on an Electrical Power System Testbed

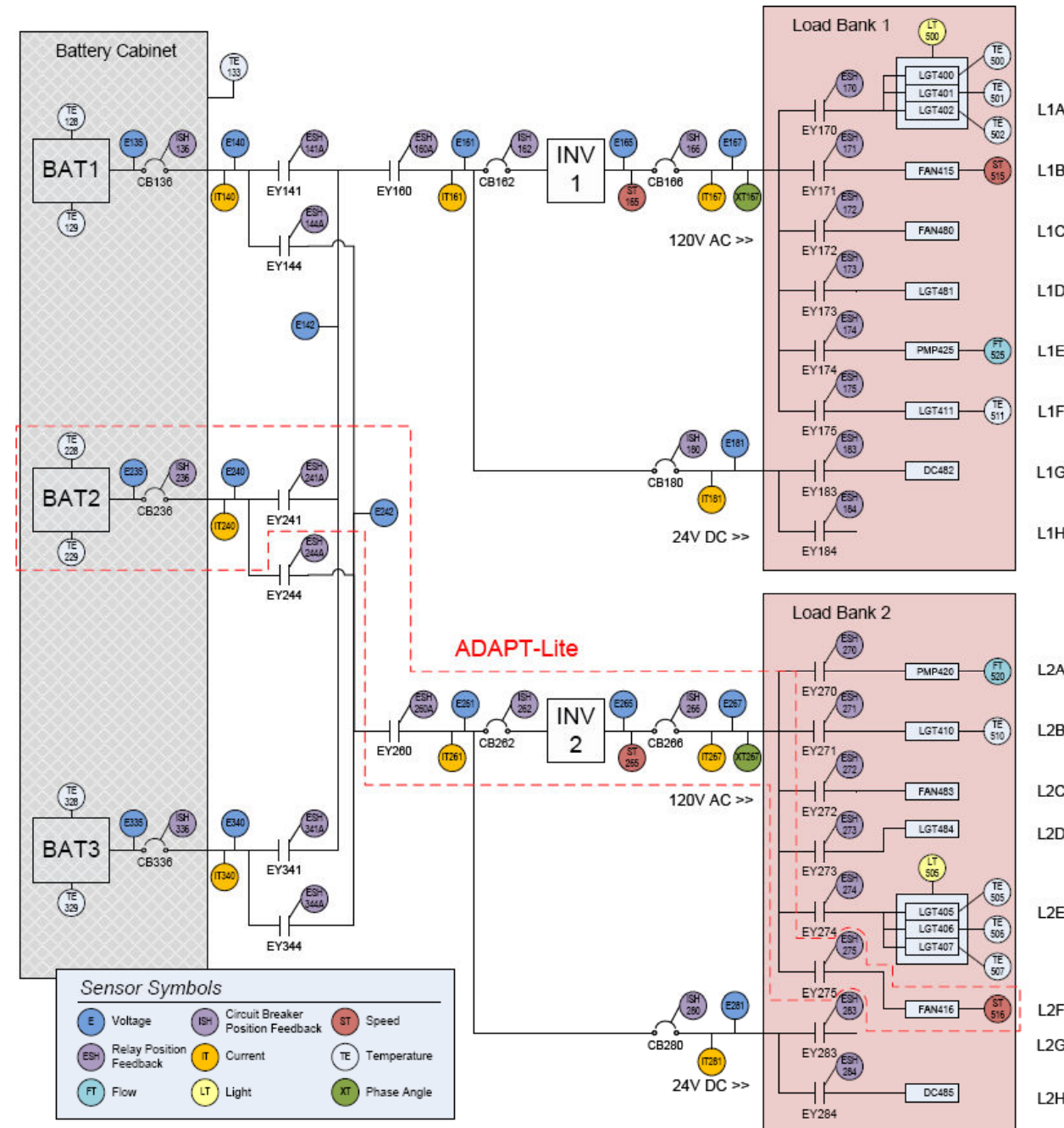
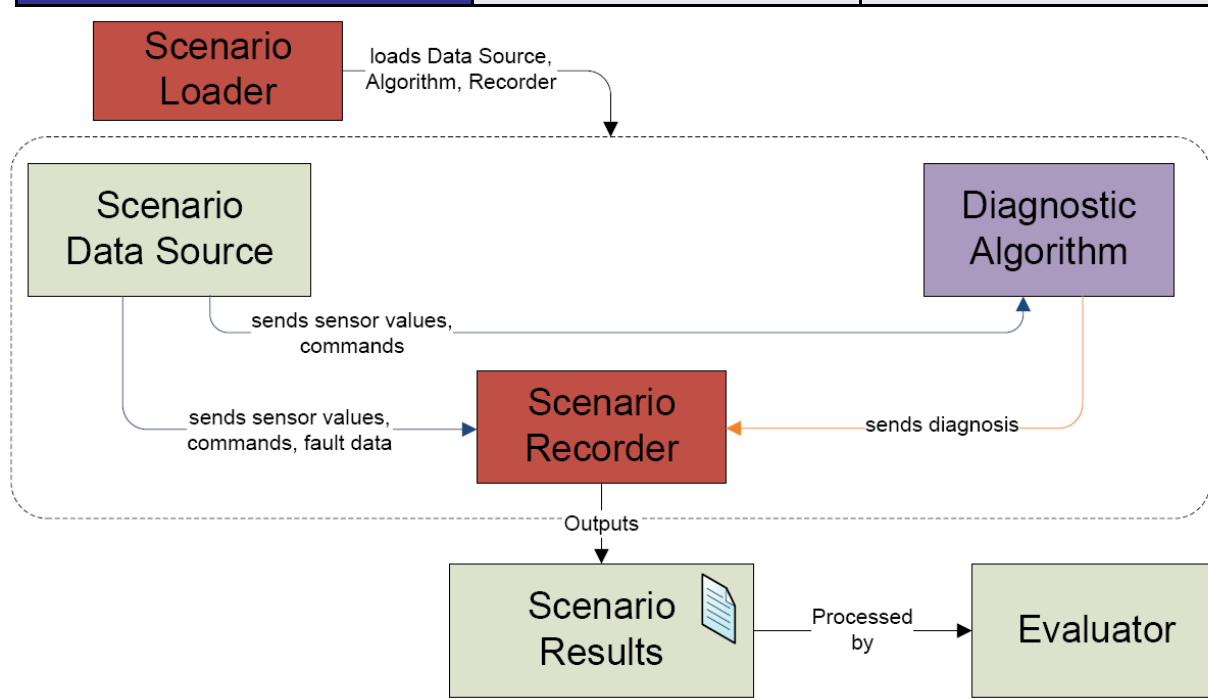
Tolga Kurtoglu (Mission Critical Technologies @ NASA Ames), David Garcia (Stinger Ghaffarian Technologies @ NASA Ames), Scott Poll (NASA Ames), Sriram Narasimhan (UARC @ NASA Ames), Stephanie Wright (Vanderbilt University)

Overview



System and Methodology

Aspect	ADAPT-Lite	ADAPT
#Comps/Modes	37/93	173/430
Initial State	Relays closed; circuit breakers closed	Relays open; circuit breakers closed
Nominal Mode Changes?	No	Yes



Performance Metrics

Name	Description	Class/Category
"Per System Description" Metrics		
False Positives Rate	Spurious faults rate	Technical / Detection
False Negatives Rate	Missed faults rate	Technical / Detection
Detection Accuracy	Correctness of the detection	Technical / Detection
"Per Scenario" Metrics		
Fault Detection Time	Time for detecting a fault	Temporal / Detection
Fault Isolation Time	Time for last persistent diagnosis	Temporal / Isolation
Classification Errors	Number of mode classification errors	Technical / Isolation
CPU Load	CPU time spent	Computational / Detection & Isolation
Memory Load	Memory allocated	Computational / Detection & Isolation

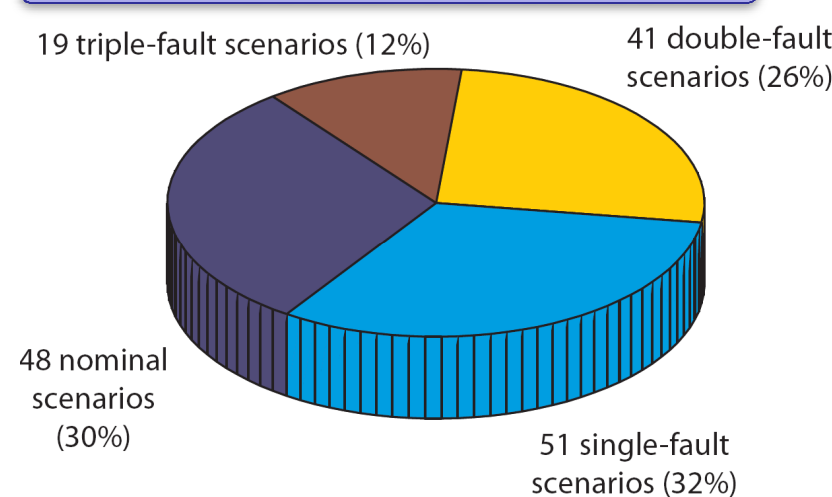
Results

Name	System	Algorithm Type
FACT	AL	Model-based
Fault Buster	A, AL	Statistical
GoalArt	A	Flow-models
HyDE-A	A, AL	Model-based
HyDE-S	AL	Model-based
Lydia	A, AL	Model-based
NGDE	AL	Model-based
ProADAPT	A, AL	Probabilistic
RacerX	AL	Change detection
RODON	A, AL	Model-based
RulesRule	AL	Rule-based
StanfordDA	A	Optimization
Wizards of Oz	A, AL	Model-based

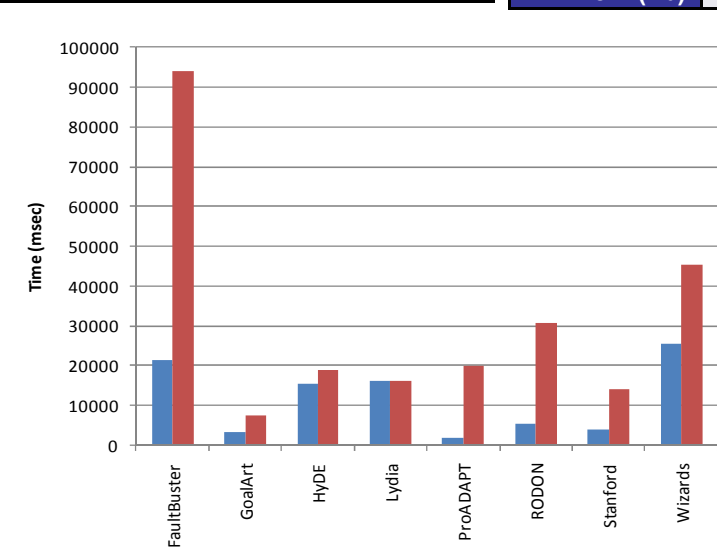
ADAPT-Lite (AL)											
	FACT	Fault Buster	HyDE-A	HyDE-S	Lydia	NGDE	Pro ADAPT	RacerX	RODON	Rules Rule	Wizards
FP Rate	0.109	0.011	0.000	0.380	0.011	0.033	0.011	0.033	0.011	0.326	0.000
FN Rate	0.000	0.500	0.464	0.036	0.179	0.125	0.054	0.196	0.036	0.089	0.500
Det Acc	0.891	0.891	0.685	0.717	0.598	0.880	0.957	0.848	0.967	0.620	0.696
Class Errors	44.500	11.000	56.000	45.026	66.000	100.348	10.000	56.000	4.000	63.000	43.000
T_det (ms)	1785	155	13355	121	232	194	4732	77	4204	949	12202
T_iso (ms)	10798	999999	13841	683	232	14922	7104	999999	12364	949	12327
CPU (ms)	15815	1951	23418	573	1410	21937	1905	146	12050	167	1153
Mem (kb)	4271	2569	5511	5366	1861	73031	1226	3619	28870	3784	1682

ADAPT (A)									
	Fault Buster	Goal Art	HyDE	Lydia	Pro ADAPT	RODON	Stanford	Wizards	
FP Rate	0.0252	0.0314	0.0000	0.2453	0.0881	0.0000	0.1698	0.1635	
FN Rate	0.3874	0.0541	0.3063	0.1982	0.0180	0.0270	0.0541	0.0901	
Det Acc	0.7044	0.9308	0.7862	0.6164	0.8994	0.9811	0.7925	0.7736	
Class Errors	193.0	154.0	174.3	234.9	57.0	75.6	176.6	209.2	
T_det (ms)	21255	3268	15612	16135	1743	5543	3826	25695	
T_iso (ms)	999999	7505	18923	16135	19876	30779	14226	45441	
CPU (ms)	10051	149	28807	5715	4260	85331	1012	17111	
Mem (kb)	7119	6784	19135	3412	778	31459	2213	3390	

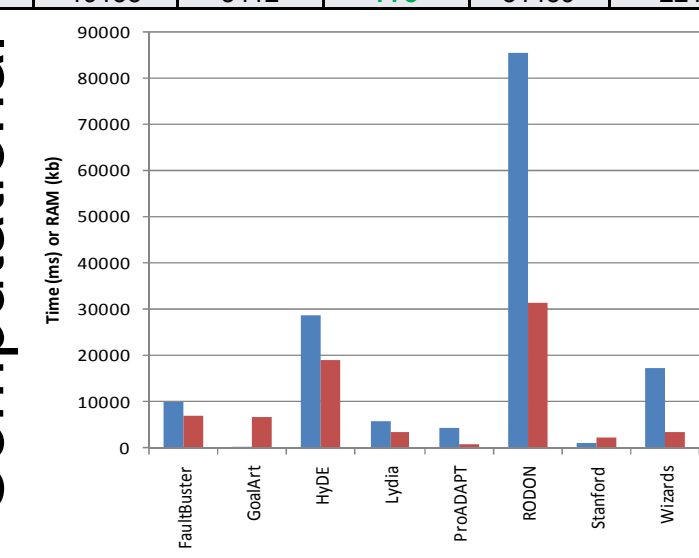
ADAPT Scenario Breakdown



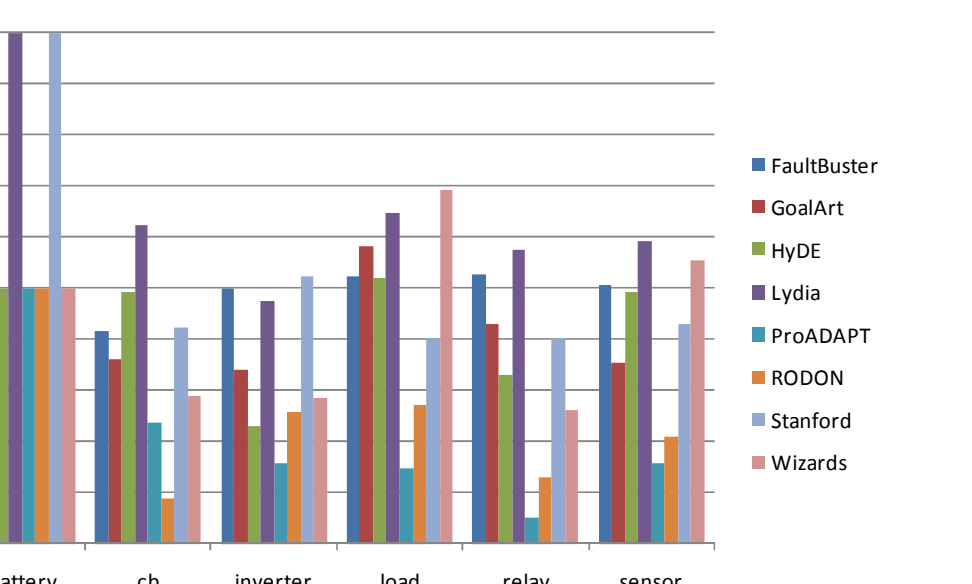
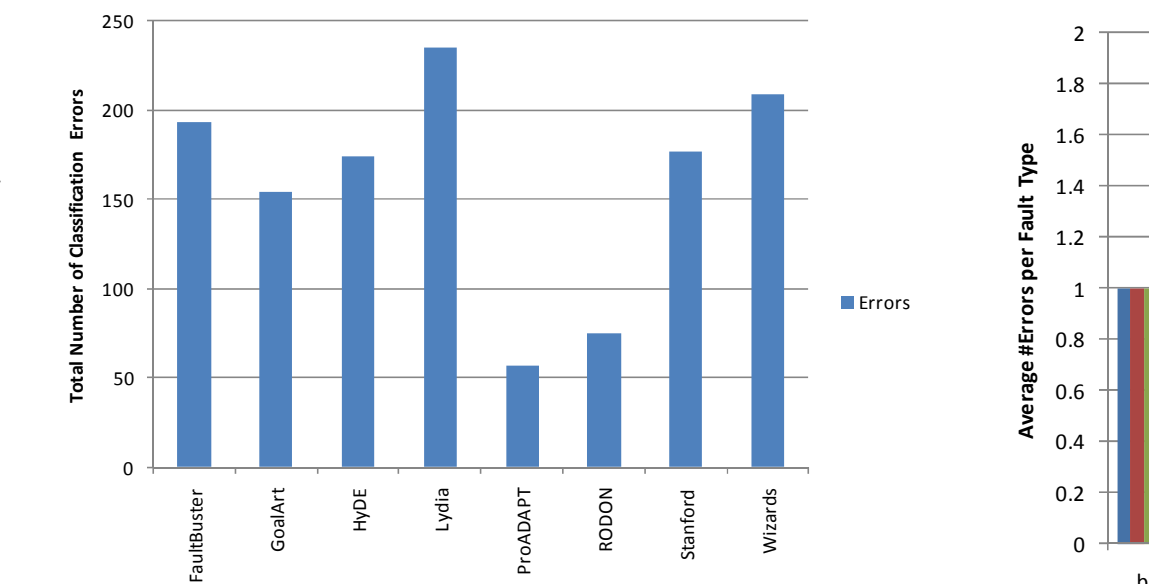
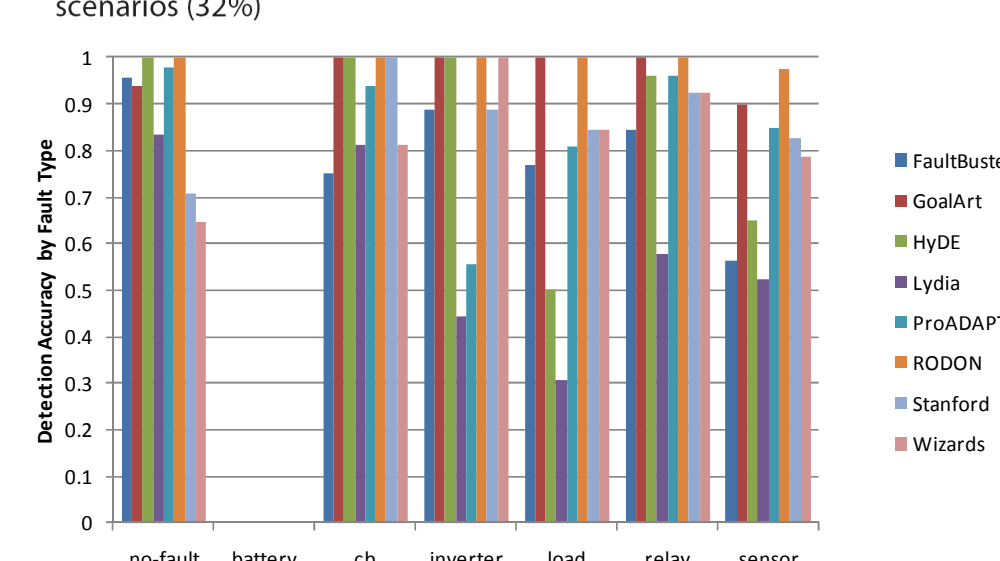
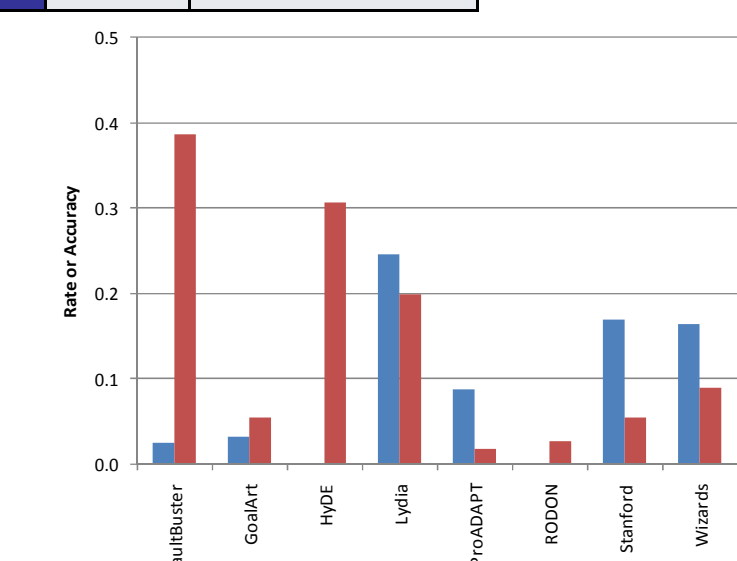
Temporal



Computational



Technical



Discussion

- Charts are for system ADAPT (ADAPT-Lite results shown in table only)
- ADAPT-Lite: single faults, no nominal transitions
- ADAPT: includes multiple simultaneous or sequential faults, nominal transitions
- No DA ranked first or second for all metrics
- Real-world system noise, latencies, and transients resulted in DA false positives and classification errors

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