

Election Integrity and Electronic Voting Machines in 2018 Georgia, USA

Berkeley-Tuskegee Data Science Initiative
Data Science Scholars Program

Philip B. Stark joint work w/ Kellie Ottoboni

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University of California, Berkeley

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Abstract. Direct recording electronic (DRE) voting systems have been shown time and time again to be vulnerable to hacking and malfunctioning. Despite mounting evidence that DREs are unfit for use, some states in the U.S. continue to use them for local, state, and federal elections. Georgia uses DREs exclusively, among many practices that have made its elections unfair and insecure. We give a brief history of election security and integrity in Georgia from the early 2000s to the 2018 election. Nonparametric permutation tests give strong evidence that something caused DREs not to record a substantial number of votes in this election. The undervote rate in the Lieutenant Governor’s race was far higher for voters who used DREs than for voters who used paper ballots. Undervote rates were strongly associated with ethnicity, with higher undervote rates in precincts where the percentage of Black voters was higher. There is specific evidence of DRE malfunction, too: one of the seven DREs in the Winterville Train Depot polling place had results that appear to be “flipped” along party lines. None of these associations or anomalies can reasonably be ascribed to chance.

Keywords: Permutation testing, anomaly detection, DREs

What happened in GA, 2018?

politico.com/news/magazine/2022/03/18/brian-kemp-david-perdue-donald-trump-2020-0018601

by Matt

How Brian Kemp Resisted Trump's Pressure to Overturn the Georgia Election Results

Other state Republicans were tempted to cave to Trump's demands. The GOP governor held firm.



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How Brian Kemp Resisted Trump's Pressure to Overturn the Georgia Election Results

Other state Republicans were tempted to cave to Trump's demands. The GOP governor held firm.



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Fanatical Republican Extremist of the Day: Brian Kemp- 2023 Update

by republicansonly
Community (This content is not subject to review by Daily Kos staff prior to publication.)

Sunday, July 30, 2023 at 1:15:45a PDT

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- Lead-up to the election was fraught:
 - allegations that (then) SoS Kemp tried to suppress Black voters
 - closed polling places
 - purged voter rolls
 - history of insecure election data in GA
 - lawsuit to require paper ballots over the standard DRE voting machines
- 2018 election had anomalous results; possibly from malfunctions, misprogramming, or hacking

GA: long history of voter suppression

- Voting Rights Act (1965)
 - Prevents racial discrimination in voting
 - Section 5 required certain states to get “preclearance” before changing voting procedures that might affect minority voters
- Shelby County v. Holder (2013) overturned the preclearance rule
 - Since then, election officials in Georgia closed nearly 8% of the state’s polling places
- Kemp’s “exact match” law: requires name on voter registration application to exactly match the legal name
 - Any discrepancy renders the registration “pending”.
 - In 2018, 53,000 voter registrations were pending. 70% were from Black voters.

Help America Vote Act (HAVA) and DREs

- HAVA passed in 2002 in response to serious problems with punchcard voting machines in the 2000 election
 - Gave states funding to upgrade from punchcard and lever systems, among other requirements
 - Many states used funding to purchase touchscreen DREs
- Premier (later ES&S) was voting system vendor for Georgia
 - DRE with serious known security problems
 - Ties to the Republican party and state officials, incl. member of Kemp's administration
 - Lied to congress about remote desktop software, radios, etc.
 - Fined \$2.9MM in Philadelphia

Security Analysis of the Diebold AccuVote-TS Voting Machine

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Abstract

This paper presents a fully independent security study of a Diebold AccuVote-TS voting machine, including its hardware and software. We obtained the machine from a private party. Analysis of the machine, in light of real election procedures, shows that it is vulnerable to extremely serious attacks. For example, an attacker who gets physical access to a machine or its removable memory card for as little as one minute could install malicious code; malicious code on a machine could steal votes undetectably, modifying all records, logs, and counters to be consistent with the fraudulent vote count it creates. An attacker could also create malicious code that spreads automatically and silently from machine to machine during normal election activities—a voting-machine virus. We have constructed working demonstrations of these attacks in our lab. Mitigating these threats will require changes to the voting machine's hardware and software and the adoption of more rigorous election procedures.

1 Introduction

The Diebold AccuVote-TS and its newer relative the AccuVote-TSx are together the most widely deployed electronic voting platform in the United States. In the November 2006 general election, these machines were used in 385 counties representing over 10% of registered voters [12]. The majority of these counties—including all of Maryland and Georgia—employed the AccuVote-TS model. More than 33,000 of the TS machines are in service nationwide [11].

This paper reports on our study of an AccuVote-TS, which we obtained from a private party. We analyzed the machine's hardware and software, performed experiments on it, and considered whether real election practices would leave it suitably secure. We found that the machine is vulnerable to a number of extremely serious attacks that undermine the accuracy and credibility of the vote counts it produces.

Computer scientists have been skeptical of voting systems of this type, Direct Recording Electronic (DRE), which are essentially general-purpose computers running specialized election software. Experience with computer systems of all kinds shows that it is exceedingly difficult to ensure the reliability and security of complex software or to detect and diagnose problems when they do occur. Yet DREs rely fundamentally on the correct and secure operation of complex software programs. Simply put, many computer scientists doubt that paperless DREs can be made reliable and secure, and they expect that any failures of such systems would likely go undetected.

Previous security studies of DREs affirm this skepticism (e.g., [7, 18, 22, 30, 39]). Kohno, Stubblefield, Rubin, and Wallach studied a leaked version of the source code for parts of the Diebold AccuVote-TS software and found many design errors and vulnerabilities [22]. Hursti later examined the hardware and compiled firmware of AccuVote-TS and TSx systems and discovered problems with the software update mechanism that could allow malicious parties to

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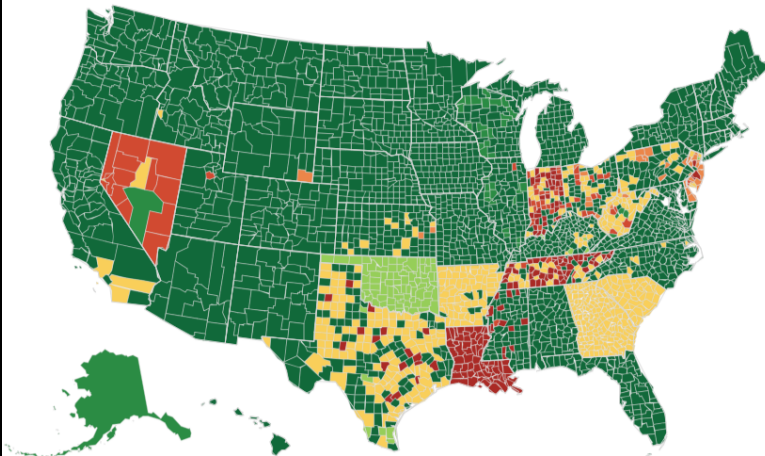


Check out the current
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Web site.





US Territories Included in All Calculations



US Territories

EXCEL | CSV | JSON

AS

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VI

Election Day Equipment

Hand marked paper ballots and BMDs	67.6%
Hand marked paper ballots and DREs with VVPAT	0.3%
Hand marked paper ballots and DREs without VVPAT	0.0%
Ballot Marking Devices for all voters	21.9%
Hybrid BMD/Tabulator for all voters	2.9%
DREs with VVPAT for all voters	2.5%
DREs without VVPAT for all voters	3.3%

- Contractor for GA to program voting machines, host VRDB, etc.
 - Director, Merle King, notable apologist for DREs

Kennesaw State

- Contractor for GA to program voting machines, host VRDB, etc.
 - Director, Merle King, notable apologist for DREs
- 2017: Logan Lamb discovered he could access Kennesaw State's Center for Election server, with critical election data (voter records, passwords, etc.)
 - entire voter registration database for the state of Georgia, including sensitive personal information
 - instructional PDFs with passwords for poll workers to sign into a central server on Election Day
 - software files for GA's ExpressPoll pollbooks
 - Lamb could have altered data (but didn't!), e.g., to prevent some voters from voting

Curling et al. v. Kemp, 2016-2018

- Lawsuit was seen in court just months before the 2018 election
 - Pointed to Kennesaw State's poor security and history of issues with DREs
- Curious behavior
 - Wiped the Kennesaw State servers, the only potential source of forensic evidence
- SoS Kemp ran against Stacey Abrams for Governor
 - Kemp was SoS overseeing the election; didn't recuse himself
 - Voter suppression continued: closed polling places, signature rejections, exact match law, etc.

Coalition for Good Governance (CGG) Suit, 2018

- Focuses on Lt. Gov contest
- Novel arguments:
 - “SoS doesn’t conduct elections”
 - programs/configures the machines (previously subcontracted to Kennesaw)
 - collects & reports the results (subcontracted to Clarity/ScytI)
 - “kill the messenger”
 - Plaintiffs and Dem party told SoS about breaches/vulnerabilities
 - SoS accused them of hacking, called in the FBI

Anomalous results

- High undervote rate (4%) in Lt. Gov contest, much higher than down-ticket contests (1.7% and below)
- Undervote rate varied substantially by mode of voting
 - Much higher rate for ballots cast on DREs
 - Higher in precincts with larger percentage of Black voters
- Evidence of unusual DRE behavior in poll tapes in Winterville Train Depot precinct

Differential Undervote Rate in Lt. Gov Contest

- Hypothesis: the undervote rate in the Lt. Governor contest did not depend on mode of voting
- Alternative: undervote rate different for DREs vs. paper (absentee by mail) ballots
- Statistical test: assume that the number of undervotes in each contest is fixed, but randomly distributed across modes of voting (hypergeometric)
- Data: reported vote totals by county and mode of voting, publically available from GA SoS website

Differential Undervote Rate for Lt. Gov, 159 GA counties

Contest	Counties w significant disparities
Lt. Governor	101
Secretary of State	4
Attorney General	4
Commissioner of Agriculture	5
Commissioner of Insurance	4
State School Superintendent	5
Commissioner of Labor	2
Public Service Commission District 3	4
Public Service Commission District 5	4

Significance: $p \leq 0.0001$

Differential Undervote Rates and Black Voters

- Data: precinct-level reported vote totals and voter registration in Fulton County
- Hypothesis: precinct differential undervote rate in Lt. Gov contest not connected to voter race
- Alternative: precinct differential undervote rate in Lt. Gov contest associated with percentage of Black voters in precinct
- Permutation test:
 - under the null, the differential undervote rate has no connection to race: race is random label
 - randomly permute differential undervote rate and compute correlation with percentage of registered Black voters by precinct

Differential Undervote Rates and Black Voters

Contest	correlation	<i>p</i> -value
Governor	-0.134	0.9903
Lt. Governor	0.557	0.0001
Secretary of State	0.092	0.0582
Attorney General	0.078	0.0902
Commissioner of Agriculture	0.207	0.0003
Commissioner of Insurance	0.246	0.0001
State School Superintendent.	0.154	0.0050
Commissioner of Labor	0.041	0.2376
Public Service Commission District 3	0.042	0.2329
Public Service Commission District 5	0.125	0.0145

Winterville Train Depot (SoS Kemp's precinct)

- 76 citizen photos of poll tapes

ELECTION RESULTS REPORT

Clarke County
State of
Georgia General Election

November 6, 2018
DATE: Nov-06-2018
POLL CTR: 70K00
1A W'ville Train Depot
MACHINE ID: 0
VERSION: 1 COPY: 0
COUNT: 0 SIZE: 32M
ACCU-VOTE RELEASE: 4, 5, 2
REPORT: US 1, 14, 7

TIME: 19:51 11/06/2018
MACHINE SERIAL: 113185
PUBLIC COUNTER: 117
SYSTEM COUNTER: 1880

** PRECINCT: 10 **

1A W'ville Train Depot

BALLOTS CAST 117

Governor
RACE # 50

B. KEMP (R) 40
S. ABRAMS (D) 73
T. METZ (L) 4

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- 76 citizen photos of poll tapes
- similar # voters used each machine:
117, 135, 131, 133, 135, 144, 135
 - 6 of 7 showed majority for D in every statewide contest
 - 1 showed majority for R in every statewide contest
 - is that surprising, if machines worked properly?

Winterville Train Depot (SoS Kemp's precinct)

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- 76 citizen photos of poll tapes
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117, 135, 131, 133, 135, 144, 135
 - 6 of 7 showed majority for D in every statewide contest
 - 1 showed majority for R in every statewide contest
 - is that surprising, if machines worked properly?
- Permutation test: voters directed to machines "as if" randomly
 - condition on votes per machine & per candidate
 - statistic: largest share discrepancy across machines

Winterville Train Depot (Kemp's precinct)

Contest	<i>p</i> -value	<i>p</i> -value if machine 3 were flipped
Governor	0.114	0.464
Lt. Governor	0.025	0.795
Secretary of State	0.018	0.450
Attorney General	0.151	0.543
Commissioner of Agriculture	0.026	0.734
Commissioner of Insurance	0.030	0.604
State School Superintendent.	0.097	0.807
Commissioner of Labor	0.008	0.797
Public Service Commission District 3	0.046	0.280
Public Service Commission District 5	0.025	0.939

Conclusions

- Evidence that DREs failed to record a large percentage of votes in Lt. Governor contest
- Evidence that some DREs malfunctioned: lost votes and/or flipped votes
- GA lawmakers replaced DREs with BMDs for all voters: at least as bad
- Procurement process ignored advice of the only technologist on the committee
- Lawsuit seeks to block universal use of BMDs in favor of HMPB

- Hand-marked paper ballots are a record of what the voter did.
- DRE records & machine-marked paper ballots are a record of what the machine did.
- BMDs make voters responsible for catching & correcting malfunctions & hacking.
- Experiments & polling-place observations show few voters check BMD printout; fewer notice errors.

Madison, Oconee, and Oglethorpe. The study, dated January 22, 2021, was not published; its existence was discovered through a Georgia Open Records Act request by *The Atlanta Journal Constitution*.² Dr. Gilbert does not mention this study.

7. The results of the Haynes and Hood (2021) study are summarized in the table below. Less than 19 percent of voters looked at the BMD printout for 5 seconds or more.

Duration of glance	Percentage of voters
did not look at all	20.0 percent
less than one second	31.3 percent
one to five seconds	29.9 percent
five seconds or more	18.8 percent

County	Contests	Minimum estimated time required to read 4 words per contest (seconds)	included in Haynes & Hood (2021)
Barrow	21	17–37	yes
Clarke	16	13–28	yes
Jackson	24	19–42	yes
Madison	23	18–40	yes
Oconee	27	22–47	yes
Oglethorpe	19	15–33	yes
Dougherty	19	15–33	no
Fulton	20	16–35	no

The Halderman Report and the MITRE Report

CYBERSECURITY

From election hero to zero: Georgia official's dismissal of security audit could mean trouble in 2024

There's no evidence the issues affected results in previous years, but they could provide openings for hackers and misinformation peddlers in 2024.



Secretary of State Brad Raffensperger's letter to legislators ramps up the rhetoric and shows that the fight for the legitimacy of the 2024 vote in Georgia is already well under way. | Patrick Semansky/AP Photo

By JOHN SAKELLARIADIS
06/23/2023 04:30 AM EDT



J. Alex Halderman
@jhalderm

Update: 20+ leading experts in cybersecurity and elections just wrote to [@MITREcorp](#) CEO Jason Providakes urging him to retract MITRE's dangerously mistaken report.
[dropbox.com/s/kujr9uqchwc...](#)

Signers include [@RonRivest](#) [@schneierblog](#) [@matthew_d_green](#)
[@ejsebes](#) [@ErrataRob](#) [@philipbstark](#)

retract this report.

This report was commissioned by Dominion Voting Systems in March 2022 and was recently unsealed by the U.S. District Court for the Northern District of Georgia in the matter of *Curling v. Raffensperger*.¹ Dominion hired MITRE to write the report in response to vulnerabilities in Georgia's Dominion voting equipment that were discovered by Prof. J. Alex Halderman of the University of Michigan and Prof. Drew Springall of Auburn University while performing court-authorized security testing for the *Curling* plaintiffs.² Their findings were confirmed by CISA, which issued a security advisory about the vulnerabilities in June 2022.³ Dominion has developed updated firmware (Democracy Suite 5.17) that purportedly addresses some of these vulnerabilities.

Unlike Halderman and Springall, MITRE NESL was not provided access to Dominion's equipment and did not perform any security testing. Instead, MITRE attempted to assess the risk posed by potential attacks described in Halderman and Springall's expert report without essential access to the source information.

MITRE's analysis applies faulty reasoning and dangerously understates the risk of exploitation, asserting that the attacks would be "operationally infeasible." This contradicts CISA's determination that "these vulnerabilities present risks that should be mitigated as soon as possible." MITRE's logic is that if procedural defenses are perfectly implemented, then the system is immune from attack. This is a completely inappropriate methodology for assessing

Evidence-Based Elections: 3 C's

- Voters *CREATE* complete, durable, verified audit trail.

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- LEO *CARES FOR* the audit trail adequately to ensure it remains complete and accurate.

Evidence-Based Elections: 3 C's

- Voters *CREATE* complete, durable, verified audit trail.
- LEO *CARES FOR* the audit trail adequately to ensure it remains complete and accurate.
- Verifiable audit *CHECKS* reported results against the paper

