

INCORPORATING TIME-OF-DAY USAGE PATTERNS INTO NON-INTRUSIVE LOAD MONITORING

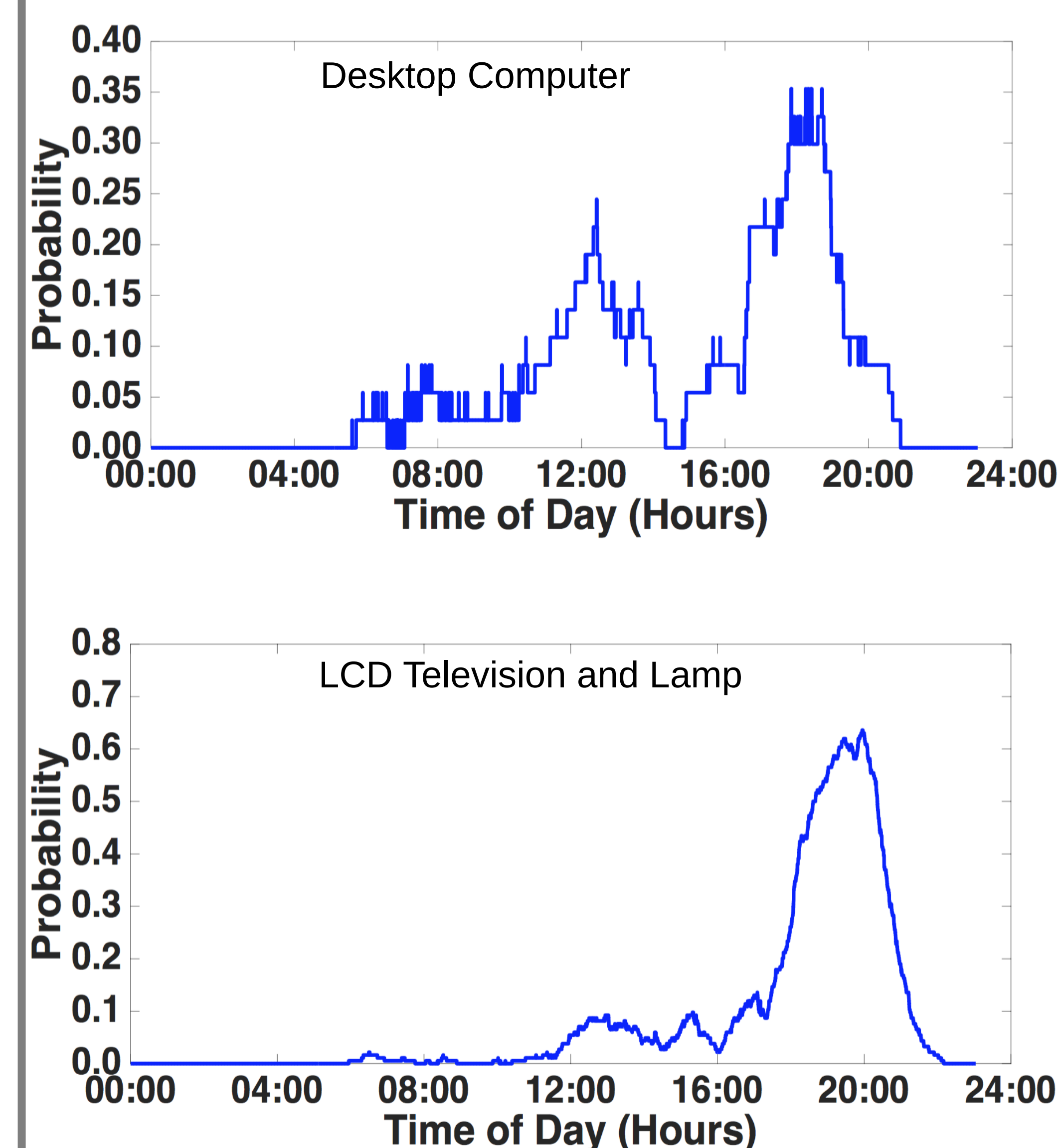
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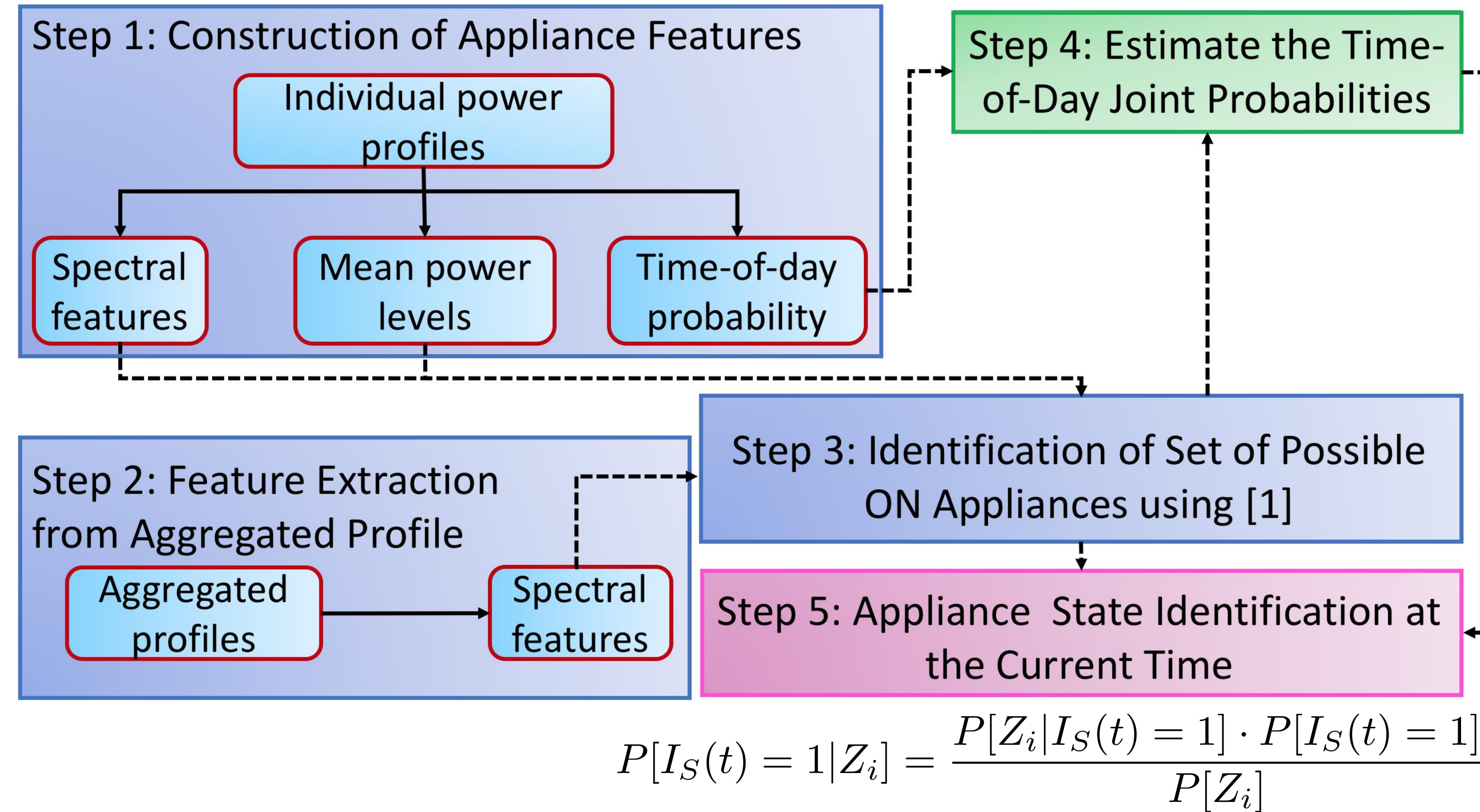
Non-Intrusive Load Monitoring

- Non-intrusive load monitoring (NILM) is known as the process of determining which appliances are ON and their respective power consumption through a single supply entry point
- Most of the existing NILM methods estimate the current ON appliances only using electrical measurements
- Certain appliances have a higher chance of being ON at certain times of day
- Therefore, there is high potential to utilize such time-of-day information for NILM

Time-of-Day Usage Patterns

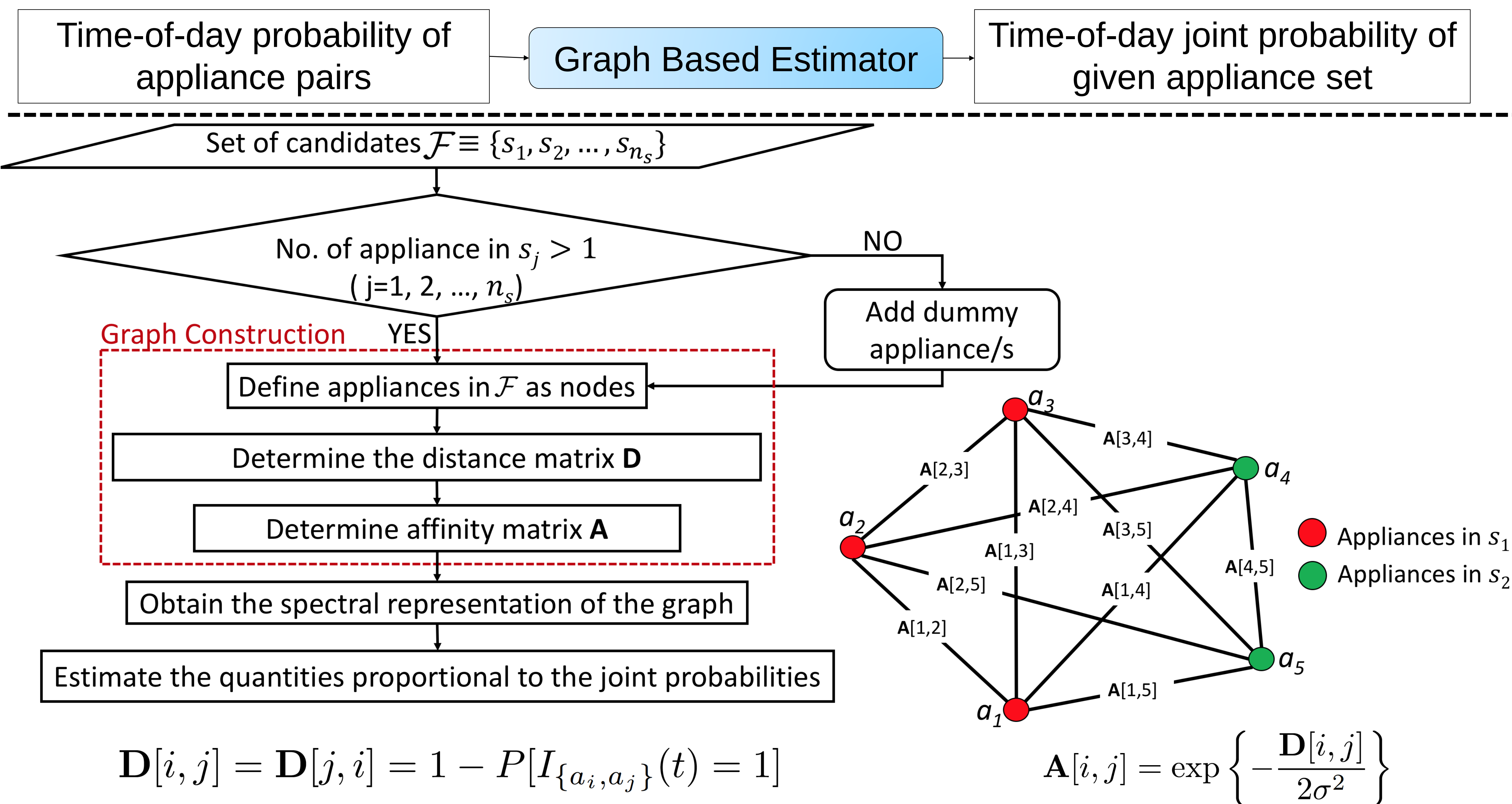


Proposed Framework



Joint Probability Estimation

	House Number					
Number of remains combinations after SES (%)	1	2	3	4	5	6
Maximum	3.1	3.3	2.1	3.5	1.8	2.9
Average	1.6	1.7	0.9	1.4	0.7	1.3

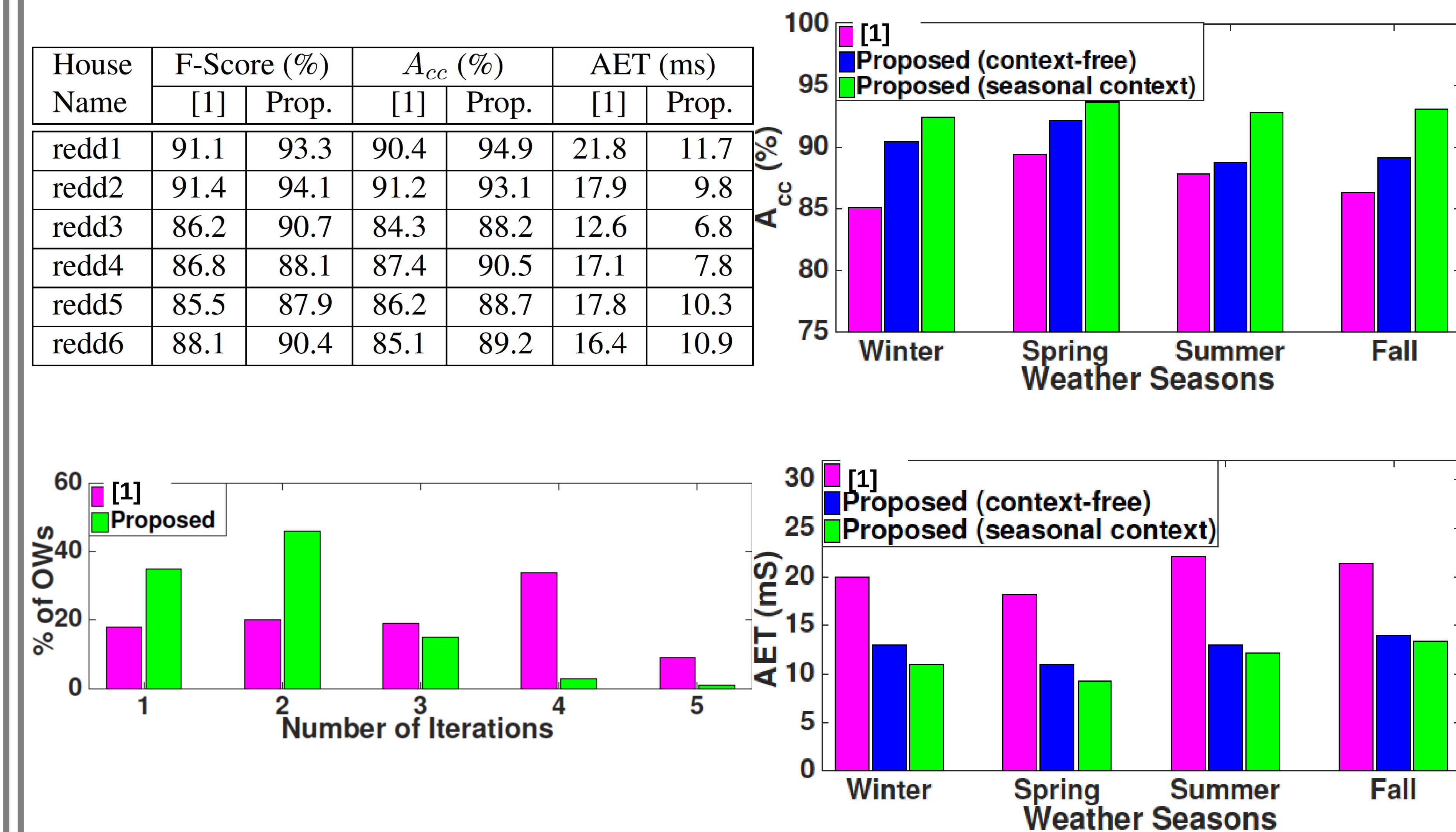


Results

Results for REDD [2] dataset:

House Name	F-Score (%)		A_{cc} (%)		AET (ms)	
	[1]	Prop.	[1]	Prop.	[1]	Prop.
redd1	91.1	93.3	90.4	94.9	21.8	11.7
redd2	91.4	94.1	91.2	93.1	17.9	9.8
redd3	86.2	90.7	84.3	88.2	12.6	6.8
redd4	86.8	88.1	87.4	90.5	17.1	7.8
redd5	85.5	87.9	86.2	88.7	17.8	10.3
redd6	88.1	90.4	85.1	89.2	16.4	10.9

Results for AMPds2 [3] data set:



Time t	Set $\mathcal{F}$	$P[I_{S_j}(t) = 1]$	$d_{\mathcal{F}}(S_j; t)$	$\frac{P[I_{S_j}(t)=1]}{d_{\mathcal{F}}(S_j; t)}$
t_1	$S_1 = \{\text{water kettle}\}$	0.383	0.371	1.032
	$S_2 = \{\text{toaster, iron}\}$	0.471	0.454	1.037
	$S_3 = \{\text{iron, lamp, projector}\}$	0.179	0.173	1.035
t_2	$S_1 = \{\text{cooking stove}\}$	0.732	0.587	1.245
	$S_2 = \{\text{toaster, lamp, desktop}\}$	0.511	0.413	1.240

Conclusions

- The appliance state identification makes use of appliance graphs that enable efficient computation of time-of-day joint probabilities.
- This helps improve both the accuracy and speed of appliance state identification.
- The results show that seasonal context helps further improve the accuracy and speed of appliance state identification.

References

- C. Dinesh et al., "Residential appliances identification based on spectral information of low frequency smart meter measurements," *IEEE Trans. Smart Grid*, vol. 7, no. 6, pp. 2781-2792.
- J. Kolter et al., "Redd: A public data set for energy disaggregation research," in *Proc. ACM SustKDD*, 2011.
- S. Makonin et al., "Electricity, water, and natural gas consumption of a residential house in Canada from 2012 to 2014," *Scientific Data*, vol. 3, no. 160037, pp. 1-12, 2016.