บันทึกข้อความ

ส่วนราชการ ภาควิชาวิศวกรรมไฟฟ้าฯ คณะวิศวกรรมศาสตร์ มหาวิทยาลัยอุบลราชธานี โทร. 3330

ที่ ศธ 0529.8.6/พิเศษ **วันที่** 16 กุมภาพันธ์ 2558

เรื่อง ขออนุมัติงบประมาณสนับสนุนการนำเสนอบทความทางวิชาการระดับนานาชาติ

เรียน รองคณบดีฝ่ายวิจัยและบริการวิชาการ ผ่านหัวหน้าภาควิชาวิศวกรรมไฟฟ้าและอิเล็กทรอนิกส์

ด้วยข้าพเจ้า นางสาวบงกช สุขอนันต์ ตำแหน่ง ผู้ช่วยศาสตราจารย์ สังกัดภาควิชาวิศวกรรมไฟฟ้าและอิเล็กทรอนิกส์ มีความประสงค์จะเข้าร่วมการนำเสนอบทความทางวิชาการระดับนานาชาติ ในการประชุมวิชาการระดับนานาชาติ ICERE 2015 International Conference on Environment and Renewable Energy ระหว่างวันที่ 20-21 พฤษภาคม 2558 ณ ประเทศออสเตรีย โดยบทความทางวิชาการที่จะนำเสนอ เรื่อง Electric Bus Transit Shortest Path and Least Energy Consumption Path Based on Traffic conditions จึงถือเป็นโอกาสอันดีในการสร้างชื่อเสียงให้กับมหาวิทยาลัยอุบลราชธานี และประเทศไทยต่อไป

ดังนั้น เพื่อให้การนำเสนอผลงานวิจัยเป็นไปด้วยความเรียบร้อย จึงใคร่ขออนุมัติทุนสนับสนุนเพื่อนำเสนอผลงานวิจัยดังกล่าว เป็นจำนวนเงิน 91,980.- บาท (-เก้าหมื่นหนึ่งพันเก้าร้อยแปดสิบบาทถ้วน-) ซึ่งมีรายละเอียดดังต่อไปนี้

1.	ค่าลงทะเบียน (EUR350)	จำนวน 14,000 บาท
2.	ค่ายานพาหนะระหว่างประเทศ	จำนวน 35,000 บาท
3.	ค่าเช่าที่พักในต่างประเทศ (7,500 บาท x 3 คืน)	จำนวน 22,500 บาท
4.	ค่าพาหนะประจำทางและรถรับจ้างในต่างประเทศ	จำนวน 4,000 บาท
5.	ค่าเบี้ยเลี้ยงในต่างประเทศ (2,100 บาท x 5 วัน)	จำนวน 10,500 บาท
6.	ค่าเครื่องบินและรถรับจ้างภายในประเทศ	จำนวน 5,500 บาท
7.	ค่าเบี้ยเลี้ยงภายในประเทศ (240 บาท x 2 วัน)	จำนวน 480 บาท
	รวมเป็นเงินทั้งสิ้น	**จำนวน 91,980 บาท**

ทั้งนี้ ข้าพเจ้าขออนุมัติทุนสนับสนุนตามค่าใช้จ่ายจริงไม่เกิน 40,000.- บาท (-สี่หมื่นบาทถ้วน-)

จึงเรียนมาเพื่อโปรดพิจารณา

ผ่าน ERB [illegible] 20 กพ 58

(ผู้ช่วยศาสตราจารย์ ดร.บงกช สุขอนันต์)
ผู้ช่วยศาสตราจารย์สังกัดภาควิชาวิศวกรรมไฟฟ้าและอิเล็กทรอนิกส์

เรียน รองคณบดีฝ่ายวิจัยและบริการวิชาการ
เพื่อโปรดพิจารณา

(ผู้ช่วยศาสตราจารย์ ดร.วรการ วงศ์สายเชื้อ)
หัวหน้าภาควิชาวิศวกรรมไฟฟ้าและอิเล็กทรอนิกส์

เรียน รองคณบดีฝ่ายวิจัยและบริการวิชาการ
ตามที่ ผศ.ดร.บงกช สุขอนันต์ได้
ขอทุนสนับสนุนการนำเสนอผลงานในต่างประเทศ
[illegible]
[illegible] ERB
[illegible]
19 กพ.58

สรุปรายละเอียดค่าใช้จ่าย

ประชุมวิชาการระดับนานาชาติ "International Conference on Environment and Renewable Energy(ICERE 2015) "

เรื่อง " Electric Bus Transit Shortest Path and Least Energy Consumption Path Based on Traffic conditions"

ระหว่างวันที่ 20-21 พฤษภาคม 2558 ณ ประเทศออสเตรีย

หมวดรายจ่าย	รายการ	คณะ	ม.อุบลฯ	หมายเหตุ
1. ค่าตอบแทน :- - ไม่มี -				
รวม		-	-	
2. ค่าใช้สอย:-				
2.1 ค่าพาหนะต่างประเทศ	- ค่าเครื่องบิน กรุงเทพฯ - ออสเตรีย - กรุงเทพฯ		35,000.00	
	- ค่ารถรับจ้าง สนามบินออสเตรีย - โรงแรม - สนามบินออสเตรีย	4,000.00		
2.2 ค่าพาหนะในประเทศ	- ค่าเครื่องบิน อุบลฯ - กรุงเทพฯ - อุบลฯ	4,000.00		
	- ค่ารถรับจ้างภายในประเทศ	1,500.00		
2.3 ค่าลงทะเบียน	- ค่าลงทะเบียน		14,000.00	
2.4 ค่าที่พักในต่างประเทศ	- ค่าที่พักต่างประเทศ 3 คืน x 7,500 บาท	22,500.00		
2.5 ค่าเบี้ยเลี้ยงต่างประเทศ	- ค่าเบี้ยเลี้ยง 5 วัน x 2,100 บาท	10,500.00		
2.6 ค่าเบี้ยเลี้ยงในประเทศ	- ค่าเบี้ยเลี้ยง 2 วัน x 240 บาท	480.00		
รวม		**42,980.00**	**49,000.00**	
3. ค่าวัสดุ - ไม่มี -				
รวม		-	-	
	รวมทั้งสิ้น	**42,980.00**	**49,000.00**	

หมายเหตุ ได้รับงบประมาณสนับสนุนจากมหาวิทยาลัยอุบลราชธานี จำนวน 40,000.-บาท ตามหมวดรายจ่ายดังกล่าว ดังนั้น ส่วนที่เหลือจะขอเบิกจากคณะวิศวกรรมศาสตร์ ภายใต้วงเงิน 40,000.-บาท ในจำนวนงบประมาณที่เท่ากัน

ICERE 2015

International Conference on Environment and Renewable Energy.

20-21 May 2015, Vienna, Austria

Assist. Prof Bongkoj Sookanata

Department of Electrical and Electronics Engineering, Ubon Rachatani University, Ubon Rachatani, THAILAND

INVITATION

Dear Assist. Prof Bongkoj Sookanata

We are pleased to invite you to the 2015 International Conference on Environment and Renewable Energy which will be held 20-21 May in at the Grand Hotel Wien . We confirm that the full paper of Assist. Prof Bongkoj Sookanata " **Electric Bus Transit Shortest Path and Least Energy Consumption Path Based on Traffic Conditions** ' has been reviewed and accepted for Oral Presentation at the conference and publication in the Proceedings. We ask Austrian consulate to issue visa to Assist. Prof . Bongkoj Sookanata for the period of the conference. For updates about program, résidence, visa and other necessary information, please visit our website. In case of any questions please contact +43 660 5498409 or email adeo.office@gmail.com

Sincerely,
Elena Ringo
Technical Organizing Committee,
Editor-in-Chief of the International Scientific Journal
18.02.2014

+43 676 9673772

Adeo.office@gmail.com
http://energy.conference-site.com/

ICERE 2015

International Conference on Environment
and Renewable Energy
Vienna, Austria 20-21 May 2015

Home | Register | Abstracts | Dates | Committee | Venue | Contact | Links

ICERE 2015

International Conference on Environment and Renewable Energy

20-21 May 2015, Vienna, Austria

Registration is open. Please submit your abstracts.

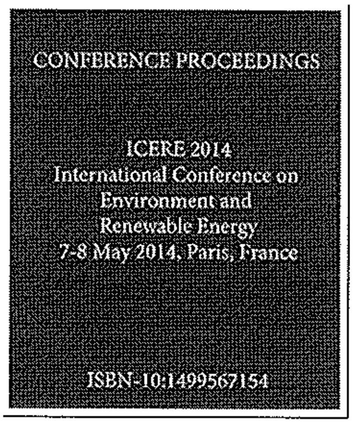
Welcome to the official website of the 2015 International Conference on Environment and Renewable Energy.

It will be held 20-21 May in at the Grand Hotel Wien.

ICERE 2015, is to bring together innovative academics and industrial experts in the field of Environment and Renewable Energy to a common forum.

Previous Conference ICERE 2014 in Cité Internationale Universitaire de Paris, France

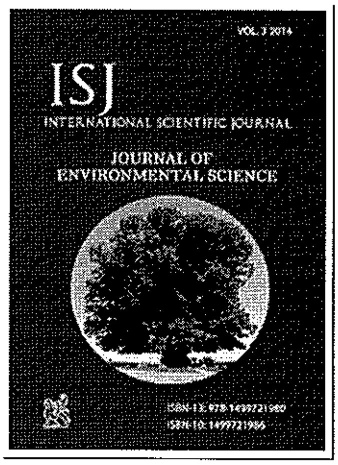
Photos of the conference



You can download the proceedings here

The aim of this conference is to promote environmentally safe and economically sustainable renewable energy, to create theoretical base of the utilization and implementation of renewable energy sources.

Another goal is to promote research in the field of Environmental science and development of renewable energy and to facilitate exchange of new ideas in these fields and to create a dialogue between scientists and practitioners.



Journal of Environmental Science is available at Amazon

Please submit your abstract and it will be reviewed by the editors of the International Scientific Journal and independent reviewers.

All of the selected papers will be published in Proceedings in E-Format and are eligible for free publication in the Journal of Environmental Science.

Topics will include, but will not be limited to

- Climate change
- Global warming
- New perspectives of renewable energy
- Wind energy technologies
- Solar energy technologies
- Biomass industries
- Waste to energy
- Heating and cooling applications
- Low energy architecture
- Energy saving in buildings
- Hydro power
- Renewable energy economics

Vienna is the most beautiful city in Europe. The sightseeing tour organized during the conference will not only serve educational purposes, but will also help participants to establish necessary contacts.

 22

ICERE 2015

International Conference on Environment and Renewable Energy
Vienna, Austria 20-21 May 2015

ICERE 2015

Register

Please fill the registration form and send.

In case you need invitation for visa purpose, your registration form should be sent together with the receipt of the full payment.

Important visa information:
Please note, that you will need about 3 months to get Austrian Visa
So, we suggest that you register early, and apply for Austrian Visa 3 months before the conference.

You can register without submitting the abstract.

WE ARE NON - PROFIT ORGANISATION AND NOT IN A POSITION TO SPONSOR ANY DELEGATES

Registration Fees

Meeting	Fee until 01.01.2015	Fee from 01.01.2015
Participant (Oral Presentation)	EUR 300, 00	EUR 350, 00
Participant (Listener)	EUR 250, 00	EUR 280, 00
Student	EUR 220, 00	EUR 250, 00
Keynote speaker	free	free
Poster Presentation (with attendance)	EUR 250, 00	EUR 300, 00
Poster Presentation (without attendance)	EUR 150, 00	EUR 180, 00
Accompanying Persons *	EUR 150, 00	EUR 150, 00

Participants registration fee includes:

Admission to all scientific sessions
Congress materials
Coffee, tee breaks
Opening Ceremony
Publication of scientific materials in e-format

* Participation fee of accompanying persons does not include attendance of scientific sessions. It includes the invitation

letter and the social program

ADEO Congess & Events

Tel.: +43 676 9673772
adeo.office@gmail.com

Terms and Conditions

Please note that the registrations can only be accepted and confirmed upon receipt of the completed registration form (mailed, faxed or filled and receipt of full payment.

As soon as the Organizing Secretariat has received your payment, a letter of confirmation will be e-mailed or mailed by post.

Cancellations

Refunds – minus 30 percent - will be granted to delegates unable to attend, provided written notice is received by ADEO Congress & Events by 1 January 2015. Registration fees by those who submitted an abstract or full paper cannot be refunded.

No refunds will be granted for cancellations received after this date.

Electric Bus Transit Shortest Path and Least Energy Consumption Path Based on Traffic Conditions

Bongkoj Sookanata[1], Mongkol Pusayatanont[1], Panhathai Buasri[2,*]

[1]Department of Electrical and Electronics Engineering, Ubon Rachatani University, Ubon Rachatani, THAILAND

[2]Department of Electrical Engineering, Khon Kaen University, Khon Kaen, THAILAND

Abstract: *Long vehicle driving distance increases pollution emissions for both internal combustion engine (ICE) and electric vehicles (EVs). ICE vehicle burns fossil fuels while driving but EV uses electricity based on marginal electric power sources with high green house gas (GHG) emissions. Shortest path driving distance is very importance to minimize battery energy depletion and find the most economical route for EV. In this paper, the shortest path for multiple destinations was determined for normal traffic condition. Additionally, the path with least energy consumption was determined for electric bus-transit when some subtrips have different traffic conditions. As the results, order of visited points on least energy consumption for electric bus-transit route alters to shortest path. Amount of energy difference was presented for both shortest path and least energy consumption.*

Keywords: *Electric vehicle, electric bus, shortest path, least energy consumption, traffic, estimation.*

1. Introduction

The distance driven by electric vehicle (EV) in all electric range depends on size of battery and power consumption by EV. In grid support EV, the electricity can be controlled based on types of fuels used. EV charging at peak load is discouraged due to high green house gas (GHG) emissions and high operating cost. Mix of power generation sources, fossil fuels-based and renewable energy sources can be controlled to reduce GHG emissions. In EV operation, electric motor consumes different power and energy at each driving speed to propel wheels. For a driving cycle, speed variation data are obtained by recording the vehicle in start, stop and speed up modes several times. Well-known standard driving cycles for driving in highway road and urban road are HWFET and UDDS driving cycles. Average speed and maximum speed on these driving cycles are different [1, 2]. Shortest path has been researched to find the minimum path distance between points for ICE vehicles. ICE vehicles need to fill their fuel tanks at nearest filling stations that usually located several kilometres apart alongside the road. Electrical vehicle has different charging method from ICE vehicle. Electricity can be supplied through household electric outlets connected to electrical grid or standalone power supply without grid connection for slow and fast charging electricity. The current that used for charging can be low current of 5-60 A for slow charging and high current more than 300 A for fast charging. Slow charging at 120-240 V can be set up at places with parking spaces such as shopping malls, apartments, or hotels but fast charging needs special equipment so it can be located in some places with safety protection. If charging units are widely available then driver may charge his car any time. At current state, the adoption of EV and charger are limited and infrastructure is not completed ready available. EV needs to find nearest charging unit in nearest distance or shortest path. Electric bus-transit is one of low operation cost transportation per person [3-5] and it is driven pass several stops as circular or loop driving. In this paper, the shortest path and the least energy consumption path of a TEV is studied. Subtrips with and without traffic jam are considered. The results show energy difference for both shortest path and least energy consumption path.

2. Shortest Path Problem and Algorithm

2.1 Shortest Path Problem

Electric bus -Transit is driven as loop passing multiple destinations or points. Paths between different any two points are called subtrips. Vehicles were driven at different speeds depending on traffic conditions. In Fig 1., point-A, B,D, E, F are presented. Subtrips are A-B, B-C, B-E, C-D, C-F, D-E, D-F, E-F, F-A. One point that can be connected to other points and it has various subtrips.

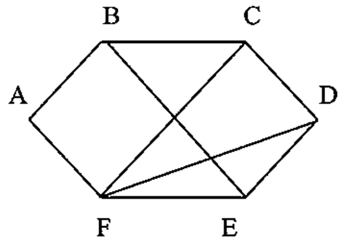


Fig.1 Multiple points and subtrips

Total distance from starting point to ending point (S_{se}) is the summation of subtrips (S_{ij}). It can be written as equation (1).

$$S_{se} = \sum_{i,j=1}^{n-1} S_{ij} \tag{1}$$

Where i and j are point numbers to be visited.

For various speeds driving, the average speed between point- i and point-j for path passing point k can be written as equation (2).

$$V_{ij} = S_{ik} + S_{jk} \Big/ \left(\frac{S_{ik}}{V_{ik}} + \frac{S_{jk}}{V_{jk}} \right) \tag{2}$$

Where S_{ik} is distance between point-i and point-k in kilometres.

V_{ik} is velocity between point-i and point-k in km/hr.

Time spent between point i and j can be calculated using equation (3)

$$t_{ij} = \frac{S_{ij}}{V_{ij}} \tag{3}$$

Where t_{ij} is traveling time from point i to point j in hour

Energy consumption between point i and j can be calculated using equation (4)

$$E_{ij} = S_{ij} \times ER \tag{4}$$

Where E_{ij} is energy consumption between point i and j in kWh

ER is rate of energy consumption in kWh/km

Shortest path problem involves finding the minimum distance of every subtrips traveled between a pair of points. The total travel distance must less than the possible distance supplied by the battery in one time charging. However EV drives on shortest path may not energy efficiency as the speed has impact on vehicle performance. For standard driving cycles such as the highway fuel economy test cycle (HWFET) and the dynamometer driving schedule (UDDS), the vehicle usage are including speed and time is repeatedly tested under road conditions and traffics on highway and urban. In UDDS, the average speed is lower than that on HWFET but energy consumption rate of EV is higher for the maximum speed of 90 and 96.4 km/h. The increasing energy consumption causes by the force variation due to acceleration and braking action on the drive tests. The energy – efficient should be considered for better energy utilization. In this paper, the number of destinations is known but the order to visit need to be specified for the shortest path and least energy consumption on traffic condition consideration.

2.2 Shortest Path Algorithm

To find the shortest path, an algorithm was implemented using Ant Colony Optimization (ACO). The Ant colony optimization is a nature inspired meta-heuristic optimization technique which mimics the behaviour of the ants working in their colony [6].

Ant Colony Optimization (ACO) application to least energy consumption was developed as the following steps,

Step 1: Load data including distance and speed, energy consumption rate during normal and busy hour, busy hour of a day
Step 2: Set parameters including number of points to be visited, maximum iteration of ACO calculation, number of ants or population, alpha and beta (using 2 and 6 respectively in this paper)
Step 3: Initialize visiting routes randomly, note that the number of routes equals number of ants
Step 4: Initialize pheromone for each visiting point to 0.1
Step 5: For shortest path, calculate visibility of the ant

$$\eta_{ij} = \frac{1}{D_{ij}} \tag{5}$$

For least energy consumption, calculate traveling time between points, check traffic condition and select energy consumption rate, then calculate visibility of the ant

$$\eta_{ij} = \frac{1}{E_{ij}} \tag{6}$$

where η_{ij} is visibility
D_{ij} is distance between point i and j
E_{ij} is energy consumption, note that during busy hour the consumption rate is 1.3 times increased

Step 6: Calculate probability of each visiting point to be visited by the ant

$$p_{ij} = \frac{\left(\tau_{ij}^{\alpha}\right)\left(\eta_{ij}^{\beta}\right)}{\sum\left(\tau_{ij}^{\alpha}\right)\left(\eta_{ij}^{\beta}\right)}$$

Where τ_{ij} is pheromone of route between point i and j, η_{ij} is visibility of the ant at point i to point j

Step 7: Select next point to be visited by chance of the route selection using probability calculated in step 6
Step 8: Update pheromone for each visiting point after it's been visited
Step 9: Calculate the energy consumption for each route and keep the least one in memory to compare with the least consumption obtained in the next iteration
Step 10: Select point to create route using step 5 to 9 until the maximum iteration is met.

3. Simulation Results

The algorithm was simulated for a route of 10-point destinations. The average velocities of electric bus during busy/normal traffic conditions are also given in the Fig.2.

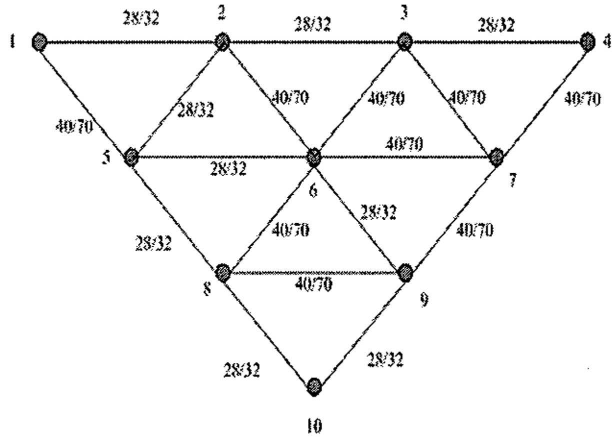


Fig 2. The studied Short Problem

Distances between points of a map shown in Fig. 2 are given in Table I.

Table I . Each Subtrip distance

Path	Distance (km)	Path	Distance (km)	Path	Distance (km)
1-2	1	3-6	6.3	6-8	8.2
2-3	1.1	3-7	9.5	6-9	3.5
3-4	2.3	4-7	10.4	7-9	9.3
1-5	6.3	5-6	3.8	8-9	8.2
2-5	4.4	6-7	6.3	8-10	3.3
2-6	7	5-8	3.8	9-10	1.8

3.1 Shortest path

In this case, the traffic condition is not considered. Using Ant Colony Optimization, the shortest path has been determined and shown in Fig 3. Distance of the path is 38.9 km. The orders of visiting points are provided in Table 2. It is assumed that the path is loop and therefore, the end point must be the same as the beginning point.

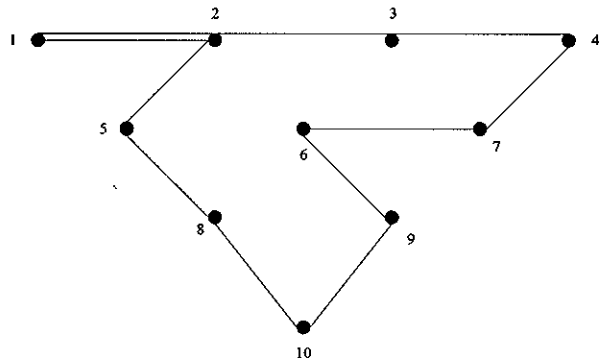


Fig 3.Shortest path without traffic considaration

Table II. The orders of visiting points for shortest path

path	orders	path	order
1	9-10-8-5-2-1-3-4-7-6-9	6	1-3-4-7-6-9-10-8-5-2-1
2	10-8-5-2-1-3-4-7-6-9-10	7	3-4-7-6-9-10-8-5-2-1-3

3	8-5-2-1-3-4-7-6-9-10-8	8	4-7-6-9-10-8-5-2-1-3-4
4	5-2-1-3-4-7-6-9-10-8-5	9	7-6-9-10-8-5-2-1-3-4-7
5	2-1-3-4-7-6-9-10-8-5-2	10	6-9-10-8-5-2-1-3-4-7-6

From the results shown in table II, every point can be a beginning point. In order to travel with shortest path, the visitor follows the path shown in Fig 2, in clockwise direction or another way round. Without consideration of traffic condition, the shortest path is also least energy consumption path under assumption that the path has unique average energy consumption rate.

3.2 The least energy consumption path with traffic condition consideration

With consideration of traffic condition, the ACO is used to determine the least energy consumption path for the trip started at 8.00 am. It is assumed that the busy hours occur during 8.00 to 8.30 am. During normal traffic condition, the average velocity is 70 km/hr for the 6.3 km and greater subtrips and 32 km/hr for the rest of subtrips. During busy hours, the average velocity is 40 km/hr for the 6.3 km and greater subtrips and 28 km/hr for the rest of subtrips. The energy consumption rate for normal and busy conditions are 160.25 and 208.33 Wh/km respectively.

In this paper, it is assumed that the traffic condition is unchanged for each subtrip. It is found that the path and orders of points is arranged as 9-10-8-5-2-1-3-4-7-6-9 for the energy consumption of 6.9213 kWh and 38.9 km. For the same path with different beginning point such as 7-6-9-10-8-5-2-1-3-4-7 can cause higher energy consumption as 6.9501 kWh

Data on driving speed and traffic condition information is needed to estimate the energy demand of a vehicle especially EVs. Driving speed can be recorded by GPS or electronic devices abut traffic conditions are difficult to get. Possible traffic conditions can be predicts from experience the traffic jam such as front of schools and workplaces on week day. The higher energy consumption of EV is expected when traffic jam occurs and average speed decreases. Shortest path may changes depending on conditions of the road. It is importance for development EV infrastructure in the future especially for electric bus-transit.

4. Conclusion

A shortest path problem was determined using Ant Colony Optimization algorithm. The solution of a shortest path problem is presented with order of points to visit. Traffic jams on some subtrips have impacts on overall energy consumption when the average speed of electric bus decreases compared to that at normal traffic condition. Least energy consumption can have minimum distance but has different order of visit points from shortest path. Both shortest path and least energy consumption should be considered for energy-efficient electric vehicles.

5. References

[1] M. Kintner-Meyer, K. Schneider, R. Pratt, "Impacts Assessment of Plug-In Hybrid Vehicles on Electric Utilities and Regional U.S Power Grids Part 1: Technical Analysis," Pacific Northwest National Laboratory, 2007

[2] Panhathai Buasri, Chaowish Munyuen, Bongkoj Sookananta, "Developed Driving Cycles for a Passenger vehicle in Khon Kaen," Advanced Materials Research, 931 – 932,593,2014

[3] H. Helm, M. Pehnt, U. Lambrecht, A. Liebich, "Electric vehicle and plug-in hybrid energy efficiency and life cycle emissions," in Proc Int. Sym. Transport and Air Pollution conf., 2010, pp.113-274.

[4] Chen-hsun Wu, Wu-Yang Sean, Yi-Hsun Hung, "Development of a real- time simulator for electric vehicle with a dual energy storage system," 2nd Int. Conf. Power Electronics and Intelligent Transportation System, pp.96-100, 2009

[5] Greg Davis, BYD electric bus , Online at http://www.byd.com/na/auto/ElectricBus.html on Dec 2014

[6] Randy L. Haupt, Sue Ellen Haupt, Practical Genetic Algorithms, second edition, John Wiley & Sons, Inc., New Jercy, Canada, 2004.