OPTIMIZATION STRATEGIES FOR SMART ENERGY SYSTEMS UNDER UNCERTAINTIES

SUMEDHA SHARMA

DEPARTMENT OF ENERGY SCIENCE AND ENGINEERING

(Formerly Centre for Energy Studies)

INDIAN INSTITUTE OF TECHNOLOGY DELHI

OCTOBER 2021

OPTIMIZATION STRATEGIES FOR SMART ENERGY SYSTEMS UNDER UNCERTAINTIES

by

SUMEDHA SHARMA

Department of Energy Science and Engineering
(Formerly Centre for Energy Studies)

Submitted
in fulfilment of the requirements of the degree of Doctor of Philosophy
to the

INDIAN INSTITUTE OF TECHNOLOGY DELHI

OCTOBER 2021

Dedicated to

My Parents & Brother

Certificate

This is to certify that the thesis entitled **"Optimization Strategies for Smart Energy Systems under Uncertainties"**, submitted by **Sumedha Sharma** to the Indian Institute of Technology Delhi, is worthy of consideration for the award of the degree of **Doctor of Philosophy** and is a record of bona fide research work carried out by her. She has worked under our supervision and guidance, and has fulfilled the requirements for the submission of this thesis.

To the best of our knowledge, the results contained in this thesis have not been submitted elsewhere in part or full for the award of any degree or diploma.

Prof. Ashu Verma
Dept. of Energy Science and Engineering,
Indian Institute of Technology Delhi
Hauz Khas, New Delhi, 110016
India

Prof. B.K. Panigrahi
Dept. of Electrical Engineering,
Indian Institute of Technology Delhi
Hauz Khas, New Delhi, 110016
India

Date:

Acknowledgements

I take this opportunity to thank all those people who contributed in my doctoral journal, both directly or indirectly. First and foremost, I would like to express my sincere thanks and deepest gratitude to my supervisors **Prof. Ashu Verma** and **Prof. B.K. Panigrahi** for their valuable guidance, incessant support and consistent encouragement throughout the tenure of my Ph.D. Their profound technical knowledge and passion towards research have inspired, shaped and nurtured my research aptitude and interests. I am deeply indebted for their time, dedication, expertise and continuous support, throughout my doctoral studies.

I would also like to thank my research committee members Prof. Viresh Dutta, Prof. T.S. Bhatti and Prof. Abhijit R. Abhyankar for their useful interactions, invaluable comments and advice. Detailed review and constructive suggestions provided by them helped me to explore greater realms and develop a broader perspective for the progress of my thesis. I am also grateful to Prof. Xu Yan, Associate Professor, Nanyang Technological University (NTU) for his guidance and encouragement. I greatly appreciate the support received from him and his research team during my stay at NTU.

I heartily express my sincere thanks to all professors at the Department of Energy Science and Engineering, IIT Delhi. Special mention and deepest thanks to Prof. T.C. Kandpal and Prof. K.A. Subramanian for their support as departmental heads, and providing the facilities required for doing the best of my research work. I also wish to convey my sincere thanks to Prof. Sumit Kumar Chattopadhyay and Prof. Dibakar Rakshit for their invaluable comments and encouragement.

I take immense pleasure in expressing my heart-felt gratitude to my fellow research scholars at the EPRES research group for providing a warm research atmosphere, sharing knowledge and personal support. I would like to extend my special thanks to Dr. Arjun Tyagi, Dr. Ram Krishan, Dr. Soumya Das, Dr. Arun Kumar V., Dr. Nikhil Pathak, Dr. Lokesh Panwar, Himanshu Grover, Rubi Rana and Sapna Verma. I am also thankful to

Bevin K.C., B.V. Surya Kiran, Manish Kumar Yadav, Kirtan Patel, Anshuman Singh, Parikshit Pareek, Gaurav Prit, Jay Ojha, Evaneet Kaur, Aakash Saini, Rahul Virmani, Bakul Kandpal, Neha Tak, Nikhilesh Wanjari, Mohd. Juned, Arinjoy Biswas, Arnab Bhattacharjee, Sonam Mittal, Nadeem Siddiquee, Mohsin Ansari, Vivek Kumar, Trishti Gupta and others who have made my life at IIT Delhi very exciting and pleasant.

Finally, I would like to thank my family whose love, blessings, motivation and patience have always been my strength. I owe my deepest gratitude to my parents Sneh Sharma and Pradeep Sharma, and my brother Sudeept Sharma for being the greatest source of inspiration and support. Their trust in my capabilities has been a key factor to all my achievements. Finally, a very special mention to my cutest nephew and nieces, Pragnay, Vedanshi and Viviksha for filling our lives with sunshine and rainbows.

Sumedha Sharma

Date:

Abstract

Energy security and access are key aspects in energy system operations, and continuous efforts are being made for development of methods and technologies for harnessing energy through cleaner and sustainable sources. Consequently, the electric grid is undergoing a shift in generation mix with increased integration of renewable energy sources (RES) at the distribution level. With gradual development of advanced control techniques and communication technology, the demand-side has emerged as a pro-active resource which can appropriately respond to the operating requirements of the power system while also ensuring the comfort of end-users. Consequently, smaller and smarter distributed energy systems such as microgrids and smart buildings have been recognized as potentially active resources with demand response (DR) capabilities to assist grid operations. Accordingly, this thesis focuses on the development of optimization strategies and algorithms for energy management in smart homes and buildings in presence of RES and load uncertainties, and further facilitate optimal utilization of building flexibility as a resource for the network operation.

Due to rising peaks and increased average load, the low-voltage (LV) distribution systems are posed with the challenges of higher losses and limit violations. A highly stressed network, in turn, leads to greater challenges to ensure network-wide energy security and continuous supply to the users. In view of this, firstly, this thesis develops a home energy management system (HEMS) to coordinate optimal scheduling of on-site resources including RES, energy storage and decentralized load curtailment (DLC) at households. While this ensures maximum satisfaction of user-priorities at the households, multiple aggregated HEMS result in reduction of peak and average loads in the network.

It is noteworthy that the presence of high proportion of thermostatic loads in buildings results in a complex interplay of electrical and thermal energy flows. This makes buildings inherently multi-energy systems. Accordingly, this thesis further

proposes building energy management systems (BEMS) for facilitating multiple (thermal and electrical) energy flows in RES-integrated buildings. In this regard, detailed models for comfort-constrained and user-oriented, thermal and electrical DR from buildings have been developed. Furthermore, timescale-decomposition has been applied to dispatch the electrical and thermal system components in two distinct time-frames, based upon their response characteristics and time constants.

Owing to the increased penetration of RES, time-of-use pricing and dynamic user-priorities, generation and load uncertainties are introduced in the energy systems. Consequently, the net-load of RES-integrated smart buildings are faced with short lead-time uncertainties. These net-load uncertainties are magnified at the utility-level since it is subjected to the load profiles of multiple buildings connected along the LV feeder. While the development of HEMS can effectively absorb uncertainties arising in residential buildings through battery control and DLC, multiple distributed HEMS have the potential to contain peak load variability in the network and minimize the effects of uncertainty occurrence on network performance.

Accordingly, this thesis further focuses on development of optimization strategies to counteract operational uncertainties encountered during real-time operation due to RES and electrical load. In this regard, a stochastic programming approach has been developed for mitigation of probabilistic uncertainties in RES and load within the smart buildings. However, in absence of well-defined probability distribution functions (PDFs) to describe the uncertain parameters, the stochastic programming approach may yield sub-optimal solutions. In view of this, the thesis further develops an adaptive robust optimization model that optimizes energy system operation for realization of any level of uncertainty, and subsequently performs real-time adjustments of optimization decision during actual system operation.

Following this, optimal coordination strategies are developed for HEMS integration in network support services. Due to relatively high R/X ratios in LV networks, increased amounts of active power flows are prominent causes of network losses and voltage drops. In view of this, a sensitivity-based approach has been developed to minimize voltage deviations through distributed residential DR. Furthermore, coordinated operation of multiple HEMS facilitates smart buildings to trade net-energy and draw greater benefits from their locally-owned DERs, in comparison to grid transactions through net-metering. However, increased flow of bidirectional power in the network may result in network limit violations. In this regard, this thesis finally develops a transactive energy framework for peer-to-peer (P2P) energy trading among smart buildings in an energy community, while considering optimal network operation at multiple operational timescales.

सार

ऊर्जा सुरक्षा और पहुंच ऊर्जा प्रणाली के संचालन में प्रमुख पहलू हैं, और स्वच्छ और टिकाऊ स्रोतों के माध्यम से ऊर्जा के दोहन के लिए विधियों और प्रौद्योगिकियों के विकास के लिए निरंतर प्रयास किए जा रहे हैं। नतीजतन, वितरण स्तर पर अक्षय ऊर्जा स्रोतों (आरईएस) के बढ़ते एकीकरण के साथ विद्युत ग्रिड उत्पादन मिश्रण में बदलाव के दौर से गुजर रहा है। उन्नत नियंत्रण तकनीकों और संचार प्रौद्योगिकी के क्रमिक विकास के साथ, मांग पक्ष एक सक्रिय संसाधन के रूप में उभरा है जो अंतिम उपयोगकर्ताओं के आराम को सुनिश्चित करते हुए बिजली प्रणाली की परिचालन आवश्यकताओं का उचित रूप से जवाब दे सकता है। नतीजतन, माइक्रोग्रिड और स्मार्ट इमारतों जैसे छोटे और स्मार्ट वितरित ऊर्जा प्रणालियों को ग्रिड संचालन में सहायता के लिए मांग प्रतिक्रिया (डीआर) क्षमताओं के साथ संभावित सक्रिय संसाधनों के रूप में मान्यता दी गई है। तदनुसार, यह थीसिस आरईएस और लोड अनिश्चितताओं की उपस्थिति में स्मार्ट घरों और इमारतों में ऊर्जा प्रबंधन के लिए अनुकूलन रणनीतियों और एल्गोरिदम के विकास पर केंद्रित है, और नेटवर्क संचालन के लिए संसाधन के रूप में लचीलेपन के निर्माण के इष्टतम उपयोग की सुविधा प्रदान करता है।

बढ़ते अधिकतम भार और बढ़े हुए औसत भार के कारण, कम-वोलटेज वितरण प्रणाली को उच्च नुकसान और सीमा उल्लंघन की चुनौतियों का सामना करना पड़ता है। एक अत्यधिक तनावग्रस्त नेटवर्क (वितरण व्यवस्था), बदले में, नेटवर्क-व्यापी ऊर्जा सुरक्षा और उपयोगकर्ताओं को निरंतर आपूर्ति सुनिश्चित करने के लिए अधिक चुनौतियों का कारण बनता है। इसे ध्यान में रखते हुए, सबसे पहले, यह थीसिस घरों में आरईएस, ऊर्जा भंडारण और विकेन्द्रीकृत लोड कटौती (डीएलसी) सहित ऑन-साइट संसाधनों के इष्टतम शेड्यूलिंग को समन्वयित करने के लिए एक घरेलू ऊर्जा प्रबंधन प्रणाली (एचईएमएस) विकसित करती है। जबकि यह घरों में उपयोगकर्ता-प्राथमिकताओं की अधिकतम संतुष्टि सुनिश्चित करता है, एकाधिक समेकित एचईएमएस के परिणामस्वरूप नेटवर्क में अधिकतम स्तर और औसत भार में कमी आती है।

यह उल्लेखनीय है कि इमारतों में थर्मोस्टेटिक भार के उच्च अनुपात की उपस्थिति के परिणामस्वरूप विद्युत और तापीय ऊर्जा प्रवाह का एक परस्पर जटिल क्रिया होती है। यह इमारतों को स्वाभाविक रूप से बहु-ऊर्जा प्रणाली बनाता है। तदनुसार, यह थीसिस आरईएस-एकीकृत भवनों में बहु (तापीय और विद्युतीय) ऊर्जा प्रवाह की सुविधा के लिए ऊर्जा प्रबंधन प्रणाली (बीईएमएस) के निर्माण का प्रस्ताव करती है। इस संबंध में, भवनों से आराम-बाधित और उपयोगकर्ता-उन्मुख, तापीय और विद्युतीय डीआर के लिए विस्तृत मॉडल विकसित किए गए हैं। इसके अलावा, विद्युत और तापीय सिस्टम घटकों को उनकी प्रतिक्रिया विशेषताओं और समय स्थिरांक के आधार पर दो अलग-अलग समय-आयाम में भेजने के लिए टाइमस्केल-अपघटन लागू किया गया है।

आरईएस की बढ़ती हुई उपयोगिता के कारण, उपयोग के समय मूल्य निर्धारण और गतिशील उपयोगकर्ता-प्राथमिकताएं, ऊर्जा प्रणालियों में उत्पादन और लोड अनिश्चितताएं पेश की जाती हैं। नतीजतन, आरईएस-एकीकृत स्मार्ट इमारतों का शुद्ध भार कम समय की अनिश्चितताओं का सामना कर रहा है। इन नेट-लोड अनिश्चितताओं को उपयोगिता-स्तर पर बढ़ाया जाता है क्योंकि यह एलवी फीडर के साथ जुड़े कई भवनों के लोड प्रोफाइल के अधीन है। जबकि एचईएमएस का विकास बैटरी नियंत्रण और डीएलसी के माध्यम से आवासीय भवनों में उत्पन्न होने वाली अनिश्चितताओं को प्रभावी ढंग से अवशोषित कर सकता है, कई वितरित एचईएमएस में नेटवर्क में पीक लोड परिवर्तनशीलता को समाहित करने और नेटवर्क प्रदर्शन पर अनिश्चितता की घटना के प्रभावों को कम करने की क्षमता है।

तदनुसार, यह थीसिस आगे आरईएस और विद्युत भार के कारण वास्तविक समय के संचालन के दौरान आने वाली परिचालन अनिश्चितताओं का मुकाबला करने के लिए अनुकूलन रणनीतियों के विकास पर केंद्रित है। इस संबंध में, स्मार्ट भवनों के भीतर आरईएस और लोड में संभाव्य अनिश्चितताओं को कम करने के लिए एक स्टोकेस्टिक प्रोग्रामिंग दृष्टिकोण विकसित किया गया है। हालांकि, अनिश्चित मापदंडों का वर्णन करने के लिए अच्छी तरह से परिभाषित संभाव्यता वितरण कार्यों (पीडीएफ) के अभाव में, स्टोकेस्टिक प्रोग्रामिंग दृष्टिकोण उप-इष्टतम समाधान प्राप्त कर सकता है। इसे देखते हुए, थीसिस आगे एक अनुकूली मजबूत अनुकूलन मॉडल विकसित करता है जो अनिश्चितता के किसी भी स्तर की प्राप्ति के लिए ऊर्जा प्रणाली के संचालन को अनुकूलित करता है, और बाद में वास्तविक सिस्टम ऑपरेशन के दौरान अनुकूलन निर्णय के वास्तविक समय समायोजन करता है।

इसके बाद, नेटवर्क समर्थन सेवाओं में एचईएमएस एकीकरण के लिए इष्टतम समन्वय रणनीतियां विकसित की जाती हैं। एलवी नेटवर्क में अपेक्षाकृत उच्च आर/एक्स अनुपात के कारण, सक्रिय बिजली प्रवाह की बढ़ी हुई मात्रा नेटवर्क हानि और वोल्टेज ड्रॉप के प्रमुख कारण हैं। इसे देखते हुए, वितरित आवासीय डीआर के माध्यम से वोल्टेज विचलन को कम करने के लिए एक संवेदनशीलता-आधारित दृष्टिकोण विकसित किया गया है। इसके अलावा, कई एचईएमएस के समन्वित संचालन से नेट-मीटरिंग के माध्यम से ग्रिड लेनदेन की तुलना में नेट-ऊर्जा का व्यापार करने और अपने स्थानीय स्वामित्व वाले डीईआर से अधिक लाभ प्राप्त करने के लिए स्मार्ट इमारतों की सुविधा मिलती है। हालाँकि, नेटवर्क में द्विदिश शक्ति के बढ़े हुए प्रवाह के परिणामस्वरूप नेटवर्क सीमा का उल्लंघन हो सकता है। इस संबंध में, यह थीसिस अंततः एक ऊर्जा समुदाय में स्मार्ट इमारतों के बीच पीयर-टू-पीयर (पी 2 पी) ऊर्जा व्यापार के लिए एक ट्रांसएक्टिव एनर्जी फ्रेमवर्क विकसित करती है, जबकि कई ऑपरेशनल टाइमस्केल्स पर इष्टतम नेटवर्क ऑपरेशन पर विचार करती है।

Contents

List of Figures

List of Tables

Abbreviations

ADMM	Alternating Direction Method of Multipliers
API	Appliance Priority Index
BEMS	Building Energy Management System
BES	Battery Energy Storage
C&CG	Column-and-Constraint Generation
CDF	Cumulative Distribution Function
CHP	Combined Heat and Power
CPP	Critical Peak Price
DER	Distributed Energy Resources
DLC	Decentralized Load Curtailment
DG	Diesel Generator
DOD	Depth-Of-Discharge
DR	Demand Response
DSM	Demand Side Management
EMS	Energy Management System
ESS	Energy Storage System
FC	Fuel Cell
FEL	Following Electrical Load
FiT	Feed in Tariff
FTL	Following Thermal Load
GRI	Grid Relief Index
HEMS	Home Energy Management System
HST	Hottest Spot Temperature
HVAC	Heating Ventilation and Air Conditioning
ICT	Information and Communication Technology
ISO	Independent System Operator
LOL	Loss Of Life

LSI	Load Satisfaction Index
LV	Low Voltage
MCS	Monte Carlo Simulation
MINLP	Mixed Integer Non-Linear Programming
MIQP	Mixed Integer Quadratic Programming
MV	Medium Voltage
P2P	Peer to Peer
PDF	Probability Distribution Function
pu	Per unit
PV	PhotoVoltaic
RES	Renewable Energy Sources
RTP	Real Time Price
SDG	Sustainable Development Goals
SOC	State Of Charge
STC	Solar Thermal Collectors
TES	Thermal Energy Storage
TOU	Time Of Use
TSRO	Two-Stage Robust Optimization
UN	United Nations
UPS	Uninterrupted Power Supply
μCCHP	micro Combined Cooling Heat and Power

Symbols

Sets

A	Set of appliances
I	Set of outgoing branches from a node
K	Set of incoming branches at a node
N_b	Set of nodes/buses
N_l	Set of lines/branches
N_p	Set of prosumers
$N_{p,s}$	Set of sellers in P2P market
$N_{p,b}$	Set of buyers in P2P market
N_{ph}	Set of phases
$\mathbb{R}^n$	n-dimensional Euclidean space
U_{pv}	Uncertainty set for PV output
$U_{d,e/L}$	Uncertainty set for electrical demand/load

Parameters

$\eta_{fuel,el}$	Fuel electric efficiency of fuel cell
η_{th}	Recovered heat efficiency of fuel cell
η_e	Electrical efficiency of fuel cell
η_s	PV module efficiency
η_r	PV module reference efficiency
η_c	Converter efficiency
$\eta_b^{c/d}$	Charging/discharging efficiency of battery
$\eta_t^{c/d}$	Charging/discharging efficiency of battery
C_g	Electricity tariff
C_{grid}	Cost of grid energy
$C_{\alpha/\beta}$	Fixed/cold-start costs of FC

C_f	Fuel cost
C_{em}	Cost of fuel carbon emissions
C_{om}	Operation and maintenance cost
C_{rep}	Battery replacement cost
C_B/C^{pen}	Penalty costs
γ/C_{dlc}	Thermal/electrical discomfort costs
∂_{em}	fuel emission factor
M_{air}	Mass of air contained in a zone
C_p	Specific heat capacity of air
R^t	Thermal resistance of building envelope
$SOC^{min/max}$	Lower and upper limits of battery SOC
$E_t^{min/max}$	Lower and upper limits of TES
$P_c^{b,max/min}$	Maximum and minimum permissible limits of charging power
$P_d^{b,max/min}$	Maximum and minimum permissible limits of discharging power
$P_d^{fc,max/min}$	Maximum and minimum permissible limits of FC output
$T_{set}^{u/l}$	Upper/lower bounds on internal temperature
δ_i^{max}	Maximum delay time of i^{th} appliance
$E_{b/t}$	Storage capacity of the BES/TES
$\tau_{TO/H}$	Top-oil/winding time constant
k_u	Ratio of ultimate load to rated load
k_i	Ratio of initial load to rated load
R	Ratio between rated loss and no-load loss
r_i/x_i	Resistance/reactance of line between the nodes i and $i+1$
U_h	Heat transfer coefficient

Variables

$A_{pr,i}$	Appliance priority index for i^{th} appliance
U_i	User preference factor for i^{th} appliance
T_i	Type of i^{th} appliance
D_i	Delay factor for i^{th} appliance
N_i	Load set/number of appliances of the same type as i
Z	Number of load types
N	Total number of time slots
$F_{pr,i}$	Relative priority of i^{th} appliance in its load set
$F_{t,i}$	Priority of load type of i^{th} appliance

P_g	Power drawn from the grid
P^{pv}	PV power output
$\pi^{pv/l}$	Time-ahead forecast of PV and electrical load
$P_{l,i}$	Power demanded by the i^{th} appliance
$P_{d,e/th}$	Electrical/thermal loads
$P_{d,e}^{f/i}$	Flexible/inflexible electrical loads
P^L/Q^L	Real/reactive load
$\varphi_{pv/l}$	Stochastic variation of the forecasted PV power/load
$P_{c/d}^b$	Total charging/discharging power of the battery
$\pi_{c/d}^b$	Battery charging/discharging powers during time-ahead scheduling
$\varphi_{c/d}^b$	Battery charging/discharging powers during real-time scheduling
P^{dlc}	Load curtailed through scheduling
π^{dlc}	Load curtailed during time-ahead scheduling
φ^{dlc}	Load curtailed during real-time scheduling
$P_{loss,R/X}^{line}$	Real/reactive components of the line loss
$P_{th/e}^{fc}$	Thermal/electrical power output of FC
$P_{th}^{c/d}$	Charging/discharging power of TES
$P_{loss}^{line/(tr,c/r)}$	Power loss in distribution lines/transformer core/copper loss
P_{ij}/Q_{ij}	Active/reactive power flows from node i to j
P_i/Q_i	Active/reactive power flow from node i to $i+1$
p_i^l/q_i^l	Real/reactive loads at i^{th} node
p_i^g/q_i^g	Real/reactive power generation at i^{th} node
l_{ij}	Square of current flowing in branch from node i to j
ΔP^{dr}	Nodal-power adjustment
$f_{\varphi_{pv/l}}$	PDF of PV/load uncertainty
μ_l	Mean value of electrical load
σ_l	Standard deviation of electrical load
α'/β'	Shape parameters of beta distribution
N_β	Normalization factor
$\mu_{pv}^{l/u}$	Lower/upper budget of PV uncertainty set
$\mu_L^{l/u}$	Lower/upper budget of load uncertainty set
Υ_i	ON/OFF decision of i^{th} appliance
X_i	operating status of the i^{th} appliance
$T_{o,i}$	Operating cycle duration for which the appliance operates
t_o	Time for which FC is in off-state

$t_{u/l}$	Time instant in upper/lower level optimization
$\tau_{b/t/s}$	Time constant of BES/TES/FC
$T_{c/p}$	Control/prediction horizon
θ_H	Hottest-spot winding temperature
$\Delta\theta_{TO}$	Top-oil rise over ambient temperature
$\Delta\theta_H$	Hottest-spot rise over top-oil temperature
$\Delta\theta_{TO}^{u/i}$	Ultimate/initial top-oil rise over ambient temperature
$\Delta\theta_H^{u/i}$	Ultimate/initial hottest-spot temperature rise over top-oil temperature
F_{AA}	Ageing acceleration factor
F_{EQA}	Equivalent ageing factor
V_i	Node voltage at the i^{th} bus
I_R/X	Real/reactive load currents
$A_{pv/stc}$	Surface area of PV module/STC
I_{pv}	Solar insolation
L_b	Battery lifetime
d_b	Depth of discharge
T_{set}	Temperature set-point obtained from user
T_{in}	Internal temperature
T_s	STC surface temperature
T_{cell}	Solar cell temperature at given time
T_r	Solar cell temperature at standard test conditions
T_{amb}/θ_A	Ambient temperature
$NOCT$	Nominal operating cell temperature
Ω_c	Fraction of total load which is controllable
Ω_{dlc}	Optimized control decision for DLC
$\xi_{c/d}$	Binary decisions for charging/discharging of BES in upper level
$\zeta_{c/d}$	Binary decisions for charging/discharging of BES in lower level
$\beta_{c/d}$	Binary decisions for charging/discharging of TES
$\phi_{b/s}$	P2P buying/selling prices
$\phi_{gb/gs}$	Grid electricity tariff/FiT
ψ_n	Preference factor of n^{th} prosumer
$F_{1,n/2}$	Utility functions of prosumer/community manager