项目主题：无线通信原理与关键技术国际暑期学校

开课院系：信息科学与工程学院

开设课程：无线通信系统概论

移动衰落信道建模

微波、毫米波与太赫兹前沿技术

开课时间：2021 年 7 月 18 日-2021 年 8 月 29 日

1.

1.1.

International Summer School of Wireless Communication Principles and Key Technologies

1.2.

School of Information Science and Engineering, Southeast University

1.3.

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This project is based on the overall advantages of information subject of Southeast University (SEU). It adheres to academic-oriented and strengthens expanding training by integrating general education, professional education, academic exchange, and innovation and entrepreneurship, thus enabling overall improvements of students ' comprehensive quality. By focusing our theme on the basic principles and technology frontiers of wireless communication systems, we set up three English courses, i.e., Introduction to Wireless Communication System, Mobile Fading Channel Modeling, and Frontiers of Microwave, Millimeter-wave and

Terahertz Technologies. Four SEU teachers, eight foreign teachers, and three company teachers will participate in this project. Each course has five parts, including theoretical teaching, experiments, talks given by international masters, talks given by company experts, and visit and discussion. From the construction of this project, students will experience classes by experts at home and abroad, be geared to international university teaching styles, closely combine theory and applications, inspire innovative thinking and learning activity, laying a solid foundation for work and research in related areas. Each course has 2 credits and 32 teaching hours. The assessment method for each course is to submit a report. The undergraduate applicants are preferred to major in electronics and information, automation, computer science or related area, and has excellent language ability. The foreign school students will get the course certificate (or other certificate of attendance) and other related instructions issued by the college after passing the three courses.

2.

2.1.

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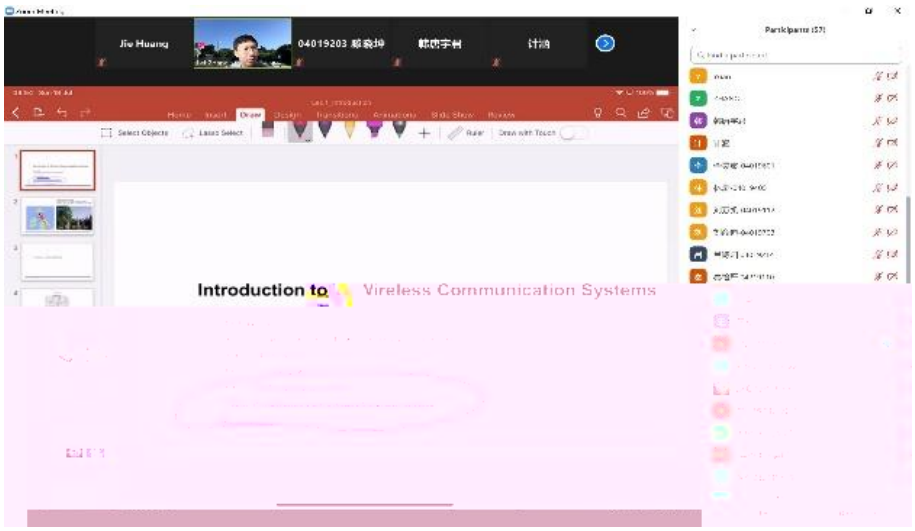
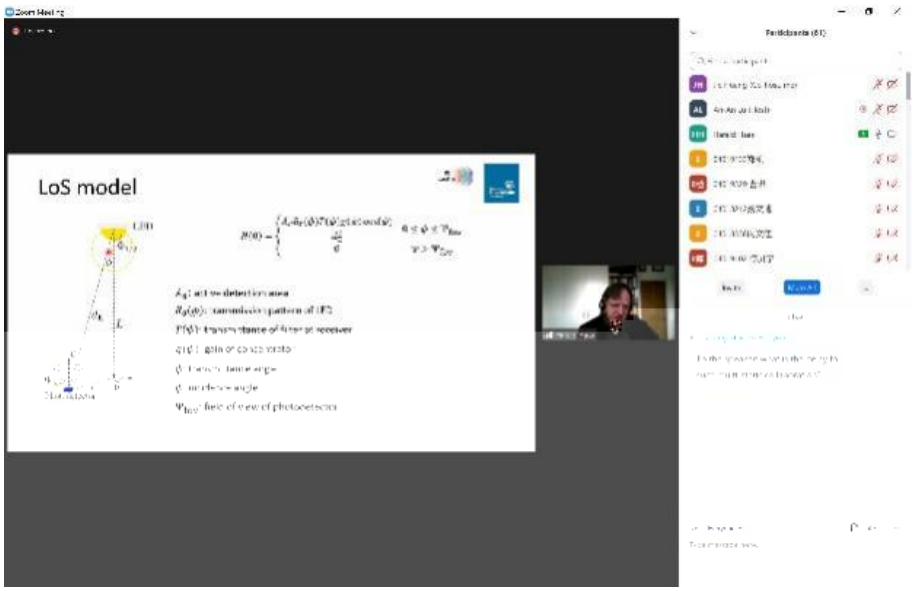
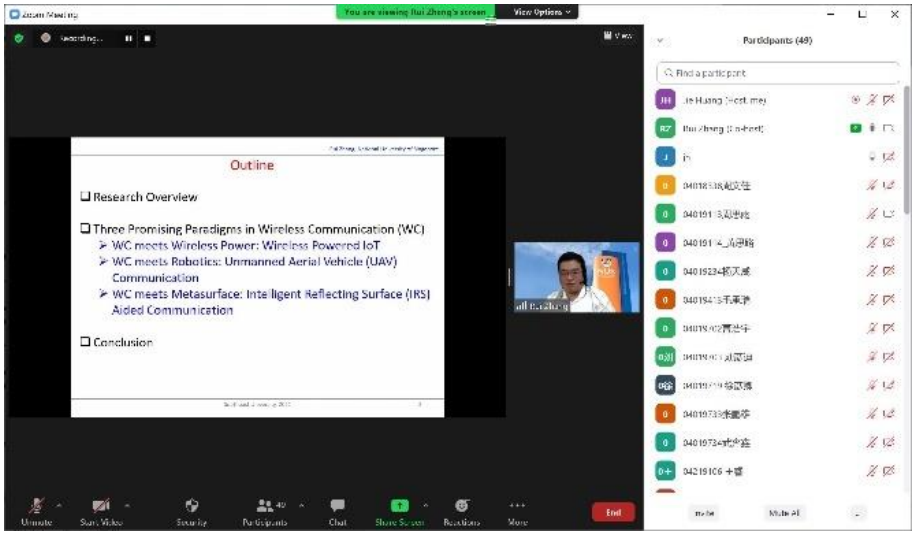
Time	Class	Content	Lecturer	Platform
18-Jul 15:45-17:20	C1-C2	Introduction to wireless communication system	Lei Zhang	Zoom ID: 516 395 1064 Passcode: 2021
19-Jul 18:30-20:05	C3-C4	Digital signal modulation and demodulation	Lei Zhang	Zoom ID: 516 395 1064 Passcode: 2021
20-Jul 18:30-20:05	C5-C6	Digital signal modulation and demodulation	Lei Zhang	Zoom ID: 516 395 1064 Passcode: 2021
21-Jul 18:30-20:55	C7-C9	Signal detection theory and BER performance analysis	Lei Zhang	Zoom ID: 516 395 1064 Passcode: 2021
22-Jul 18:30-20:55	C10-C12	Channel equalization	Lei Zhang	Zoom ID: 516 395 1064 Passcode: 2021
23-Jul 18:30-20:55	C13-C15	Channel coding and pulse shaping	Lei Zhang	Zoom ID: 516 395 1064 Passcode: 2021
25-Jul 14:00-16:30	C16-C18	Experiments	Jie Huang	Zoom ID: 516 395 1064 Passcode: 2021
25-Jul 18:30-20:55	C19-C21	Multiple access and wireless channel	Lei Zhang	Zoom ID: 516 395 1064 Passcode: 2021
26-Jul 14:00-14:45	C22	Rui Zhang ' s lecture	Rui Zhang	Zoom ID: 922 3747 7079 Passcode: 284763
27-Jul 10:00-10:45	C23	Wei Zhang ' s lecture	Wei Zhang	Zoom ID: 940 6604 2648 Passcode: 966178
27-Jul 18:30-20:55	C24-C26	Multiple access and wireless channel	Lei Zhang	Zoom ID: 516 395 1064 Passcode: 2021
29-Jul 16:00-16:45	C27	John Thompson ' s lecture	John Thompson	Zoom ID: 516 395 1064 Passcode: 2021
29-Jul	C28-C30	OFDM	Lei Zhang	Zoom ID: 516

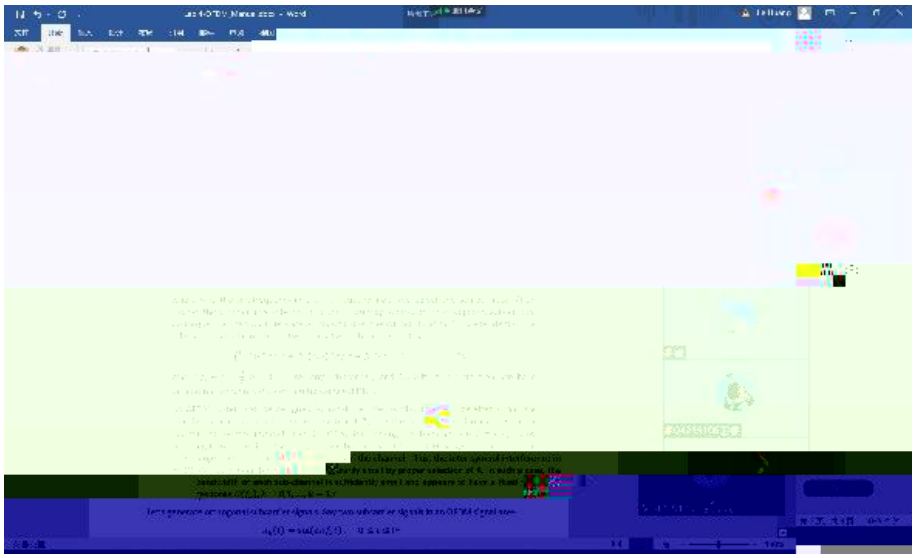
18:30-20:55				395 1064 Passcode: 2021
30-Jul 18:30-19:15	C31	Experiments and discussion	Jie Huang	Tencent ID: 574 138 285
4-Aug 19:00-19:45	C32	Jian Li ' s lecture	Jian Li	Tencent ID: 339 551 039






Outline
Research Overview
Three Promising Paradigms in Wireless Communication (WC)
WC meets Wireless Power: Wireless Powered IoT
WC meets Robotics: Unmanned Aerial Vehicle (UAV) Communication
WC meets Metasurface: Inte ligent Reflecting Surface (IRS) Aided Communication
Conclusion
Participants (49)


OFDM – symbol period, sample period, subcarrier spacing, bandwidth



2021

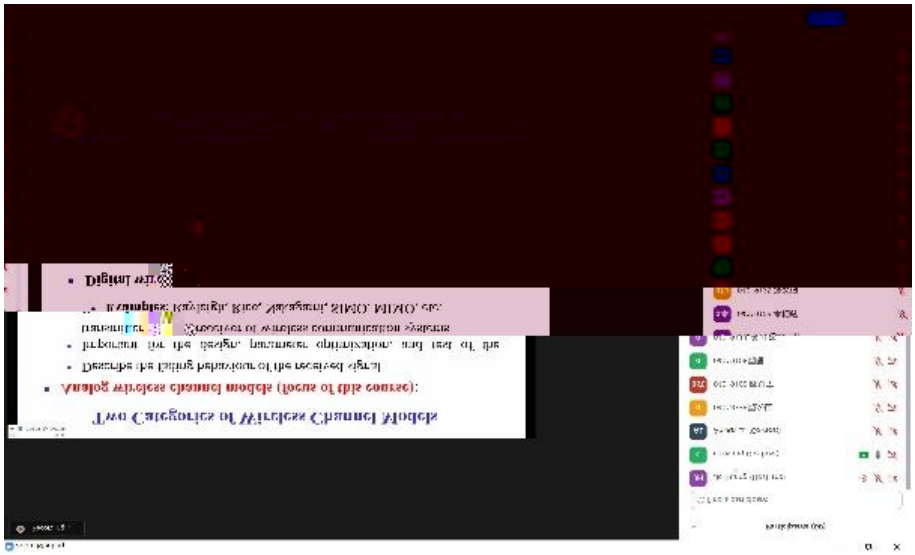
OFDM

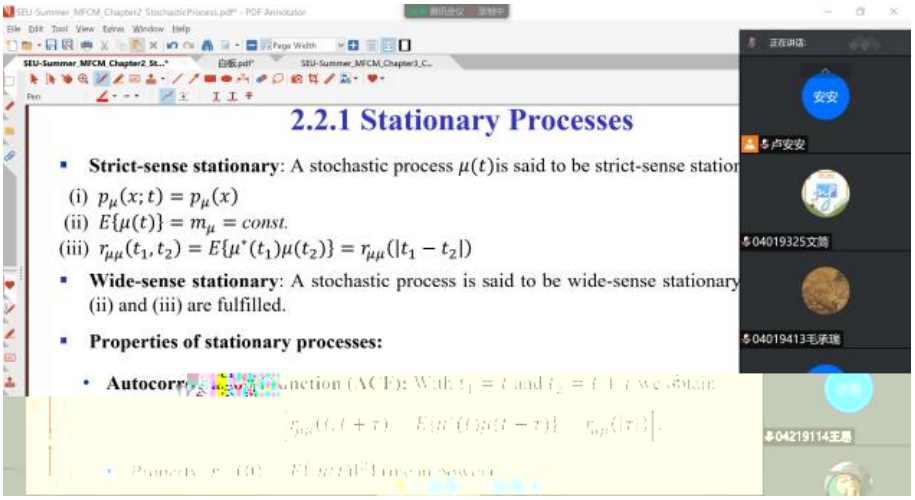
John Thompson

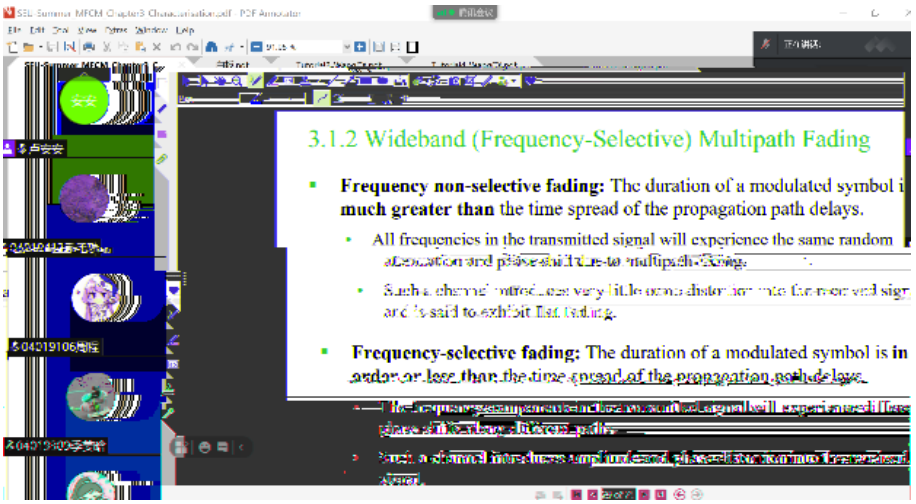
2.1.3.

Time	Class	Content	Lecturer	Platform
26-Jul 15:00-15:45	C1	Harald Haas ' s lecture	Harald Haas	Meeting ID: 336 157 0167 Passcode: G3sf22
26-Jul 18:30-20:05	C2-C3	Fundamentals of Mobile Fading Channel Modeling	Cheng-Xiang Wang	Zoom ID: 881 9214 6420 Passcode: G3sf22
28-Jul 18:30-20:05	C4-C5	Fundamentals of Mobile Fading Channel Modeling	An-An Lu	Zoom ID: 336 157 0167 Passcode: G3sf22
30-Jul 14:00-17:20	C6-C9	Random Variables, Stochastic Processes, and Deterministic Signals Characterization and Modeling of Mobile Fading Channels	An-An Lu	Tencent ID: 465 571 554
30-Jul 20:10-20:55	C10	Experiments	An-An Lu	Tencent ID: 459 811 041
2-Aug 18:30-20:05	C11-C12	Characterization and Modeling of Mobile Fading Channels	An-An Lu	Tencent ID: 789 893 425
4-Aug 14:00-17:20	C13-C16	Characterization and Modeling of Mobile Fading Channels Channel model parameter computation methods	Yang Miao	Zoom ID: 336 157 0167 Passcode: G3sf22

18:30-19:15				593 967
12-Aug 19:20-20:05	C29	Wireless Channel Models for 5G and Beyond	Jie Huang	Tencent ID: 137 593 967
13-Aug 12:00-12:45	C30	A. F. Molisch ' s Lecture	A. F. Molisch	Zoom ID: 336 157 0167 Passcode: G3sf22
13-Aug 18:30-20:05	C31-C32	Wireless Channel Models for 5G and Beyond	Jie Huang	Tencent ID: 314 706 203




2.2.1 Stationary Processes
Strict-sense stationary: A stochastic process $\mu(t)$is said to be strict-sense statio
(i) $p_\mu(x;t) = p_\mu(x)$
(ii) $E\{\mu(t)\} = m_\mu = const.$
(iii) $r_{\mu\mu}(t_1,t_2) = E\{\mu^*(t_1)\mu(t_2)\} = r_{\mu\mu}(|t_1 - t_2|)$
Wide-sense stationary: A stochastic process is said to be wide-sense stationary
(ii) and (iii) are fulfilled.
Properties of stationary processes:
Autocorr
nction (ACF): With $t_1 = t$ and $t_2 = t + \tau$ we obtain
$r_{\mu\mu}(t, t+\tau) = E\{\mu^*(t)\mu(t-\tau)\} = r_{\mu\mu}(|\tau|)$.
Property $r_{\mu\mu}(0) = E\{|\mu(t)|^2\}$ mean power
正在讲话:
安安
卢安安
04019325文简
04019413毛承瑞
04219114王易


3.1.2 Wideband (Frequency-Selective) Multipath Fading
Frequency non-selective fading: The duration of a modulated symbol i
much greater than the time spread of the propagation path delays.
All frequencies in the transmitted signal will experience the same random
Such a channel introduces very little signal distortion into the received sign
and is said to exhibit flat fading.
Frequency-selective fading: The duration of a modulated symbol is in
order or less than the time spread of the propagation path delays.
正在讲话:
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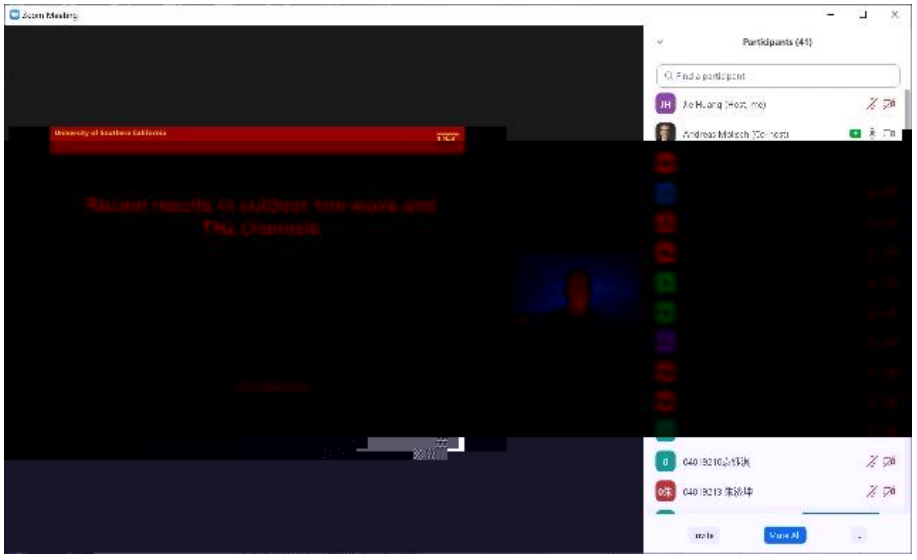

Zoom Meeting
Participants (41)
Find a participant
Joe Huang (Host, me)
Andreas Molisch (Co-host)
University of Southern California
Mute All

60%-70%

PPT

2.3.

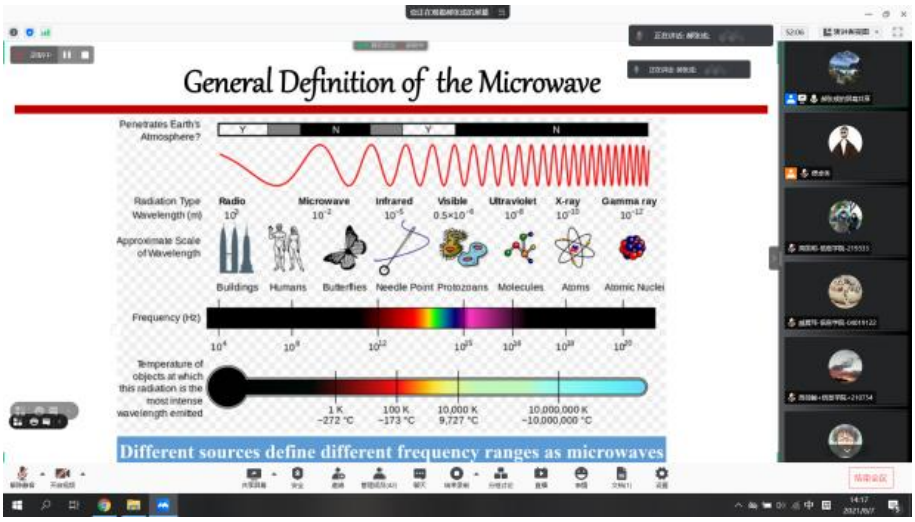
5G/6G

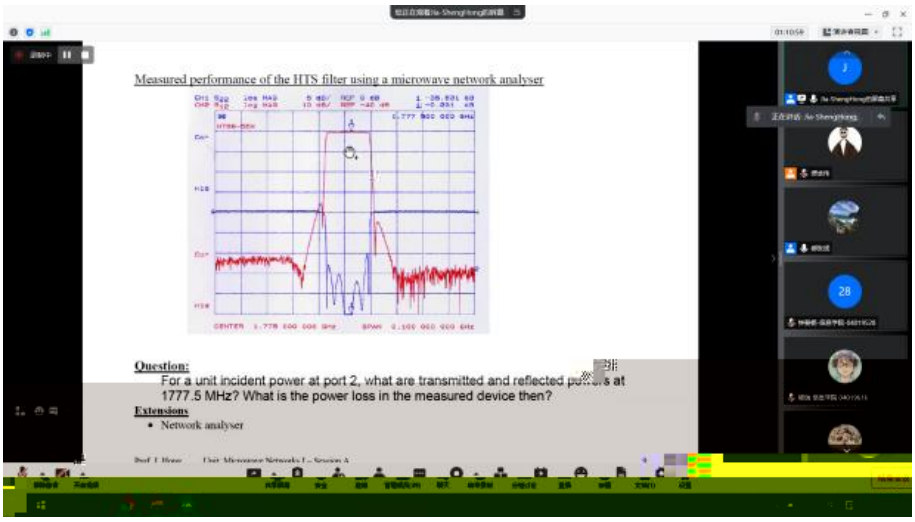
“ ”

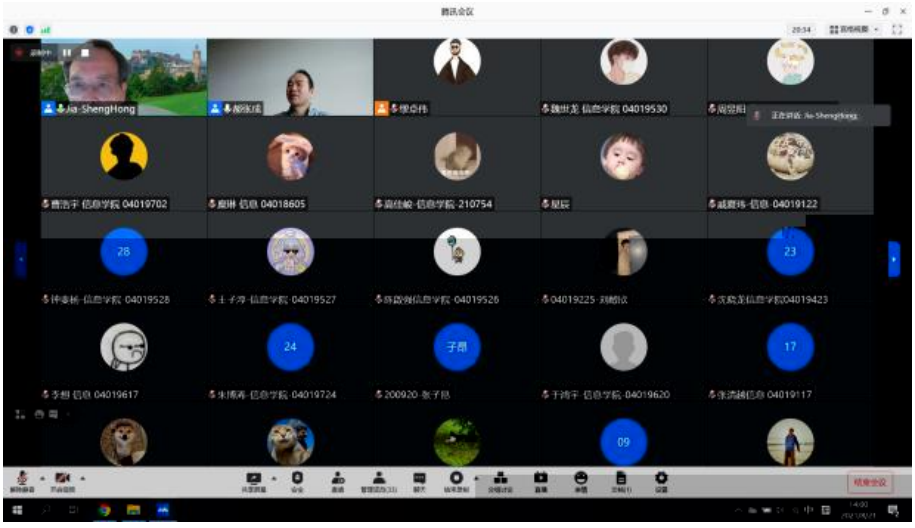
This course introduces the fundamental knowledge and application of microwave, millimeter-wave and terahertz techniques, as well as their recent developments. Specifically, following contents are introduced in detail: The development history of microwave, millimeter-wave and terahertz technology; The basic knowledge of electromagnetic equations and electromagnetic wave; Microwave network theory and its applications; Electromagnetic guided-wave theory and its applications, as well as its applications in the advanced filter design; Microwave and millimeter-wave technology in the next generation satellite and 5G/6G wireless communication systems; Basic knowledge of radar system; Advanced phased array radar technology and its recent development. This course helps students master the basic knowledge of microwave, millimeter-wave and terahertz technology, understand their applications, and establish the “field” concept of the microwave technology.

Time	**Class**	**Content**	**Lecture**	**Platform ID**
7-Aug. 14:00-17:25 (Beijing Time)	C6-C9	Introduction and Overviewing of Microwave, Millimeter-wave and Terahertz	Prof. Zhang-Cheng Hao	466 1569 3791

		Technologies		
8-Aug. 14:00-17:25 (Beijing Time)	C6-C9	Fundamental Equations of Electromagnetic Waves and Their Applications	Prof. Jia-Sheng Hong	980 4709 9431
14-Aug 14:00-17:25 (Beijing Time)	C6-C9	Microwave Network and Applications	Prof. Jia-Sheng Hong	466 1569 3791
15-Aug 14:00-17:25 (Beijing Time)	C6-C9	Guide-Wave Techniques and Fundamental Theories of Filters	Prof. Jia-Sheng Hong	980 4709 9431
21-Aug. 14:00-17:25 (Beijing Time)	C6-C9	Microwave and Miliimeter-wave Techniques in the Next Generation Satellite and 5G/6G Communication Systems	Prof. Jia-Sheng Hong	466 1569 3791
22-Aug 14:00-17:25 (Beijing Time)	C6-C9	Introduction of Radar Techniques and Relative Theory	Dr. Hong-Chao Wu	980 4709 9431
29-Aug 14:00-17:25 (Beijing Time)	C6-C9	The Modern Phase-Array Radar and its Key Techniques	Dr. Hong-Chao Wu	980 4709 9431


General Definition of the Microwave
Penetrates Earth's Atmosphere?
Y
N
Y
N
Radiation Type
Wavelength (m)
Radio
Microwave
Infrared
Visible
Ultraviolet
X-ray
Gamma ray
Approximate Scale of Wavelength
Buildings
Humans
Butterflies
Needle Point
Protozoans
Molecules
Atoms
Atomic Nuclei
Frequency (Hz)
Temperature of objects at which this radiation is the most intense wavelength emitted
1 K
-272 °C
100 K
-173 °C
10,000 K
9,727 °C
10,000,000 K
~10,000,000 °C
Different sources define different frequency ranges as microwaves


Measured performance of the HTS filter using a microwave network analyser
Question:
For a unit incident power at port 2, what are transmitted and reflected powers at 1777.5 MHz? What is the power loss in the measured device then?
Extensions
Network analyser


Jia-ShengHong
魏世龙 信息学院 04019530
曹浩宇 信息学院 04019702
崔琳 信息 04018605
温佳峻-信息学院-210754
星辰
臧夏玮-信息 04019122
钟豪杨-信息学院 04019528
王子萍-信息学院 04019527
陈路宽信息学院 04019526
04019225-刘朝汉
宋皖龙信息学院04019423
李想 信息 04019617
宋博涛-信息学院 04019724
200920-张子恩
于鸿宇-信息学院-04019620
张清扬信息 04019117


A circulator can be used as a duplexer in a transceiver to separate the transmitted and received signals. The
transmitted and received signals
different frequencies. This arrangement is quite popular for radar applications.
Transmitter
Receiver
Switches, Phase Shifters, and Attenuators
These are control devices that provide electronic control of the phase