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Additive Manufacturing and How 3D Printing is Fighting COVID-19

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1
00:00:00,140 --> 00:00:04,940
Okay I want to welcome everybody to our Shelter-in-Place Lecture Series

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00:00:04,940 --> 00:00:11,300
co-sponsored by the Faculty-Senate at Wright
State University,

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00:00:11,560 --> 00:00:16,740
and we are just so happy that we've been able
to have so many of our faculty colleagues

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00:00:16,740 --> 00:00:21,160
joining us and present extremely interesting
lectures for our community,

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00:00:21,220 --> 00:00:23,600
especially during this challenging time.

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00:00:23,640 --> 00:00:26,220
I am Laura Luehrmann professor of

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00:00:26,320 --> 00:00:27,580
political science,

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00:00:27,580 --> 00:00:32,240
and president of the faculty Senate and I'm
happy to introduce today's panelists for an

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00:00:32,240 --> 00:00:37,340
extremely interesting presentation about 3D printing.

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00:00:37,540 --> 00:00:42,180
Our first panelist is Dr. Raghavan Srinivasan
who is his professor and chair of the Mechanical

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00:00:42,180 --> 00:00:47,480
and Mechanical engineering department at Wright

State. He received his Ph.D.

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00:00:47,480 --> 00:00:49,160
in materials

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00:00:49,380 --> 00:00:54,500
science and engineering from SUNY Stony Brook
in 1983

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00:00:54,620 --> 00:00:57,760
and joined Wright State as a post Doc Fellow
in 1985

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00:00:58,000 --> 00:01:03,320
after stint as NRC research associate at the
Air Force research lab.

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00:01:03,330 --> 00:01:09,720
He has been professor in the mechanical and
materials engineering department, since 2001.

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00:01:09,720 --> 00:01:16,120
Our second panelist is Dr. Ashan Mian received
his PhD

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00:01:16,120 --> 00:01:22,470
degree in mechanical engineering from Auburn
University, in Auburn, Alabama. He's been

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00:01:22,470 --> 00:01:27,700
a faculty member of the Department of the
mechanical and materials engineering at Wright

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00:01:27,700 --> 00:01:31,780
state since January of 2013.

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00:01:31,780 --> 00:01:40,710
In addition to other faculty appointments,

he's also worked as a designer for the corporations

22
00:01:40,710 --> 00:01:43,750
automotive electronics division located in
Dearborn, Michigan.

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00:01:43,750 --> 00:01:49,620
Dr. Mian's current research focuses on additively
manufactured functional structures and this

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00:01:49,840 --> 00:01:57,440
research has been funded by NSF, NASA Department
of defense in industry.

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00:01:57,640 --> 00:02:04,240
Dr. Joy Gockel joined Wright State University
as an assistant professor in 2015. She earned

26
00:02:04,240 --> 00:02:11,690
her PhD in mechanical engineering in 2014
from Carnegie Mellon University and her bachelor's

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00:02:11,690 --> 00:02:18,860
degree in 2009 and master's degree in 2010
from Wright State University.

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00:02:18,860 --> 00:02:24,010
Prior to joining Wright State as a faculty
member, she was a lead engineer in research

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00:02:24,010 --> 00:02:29,420
and development for GE Aviation's additive technology
center.

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00:02:29,420 --> 00:02:36,840
Very happy to introduce this distinguished panel. I'll
now turn it over to Dr. Gockel.

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00:02:36,840 --> 00:02:42,190
Thank you for the introduction, and we're
excited to be here today and talk to you guys

32
00:02:42,190 --> 00:02:48,709
about additive manufacturing and 3D
printing. So our talk today we're going to

33
00:02:48,709 --> 00:02:51,750
put a little spins of COVID-19 on it.

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00:02:51,750 --> 00:02:55,920
There's been a lot of applications that you
may have seen in the news looking at how

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00:02:55,920 --> 00:03:02,510
3D printing has been used. So we're gonna start
with an introduction. So, what is additive

36
00:03:02,510 --> 00:03:04,300
manufacturing? What are the different processes?

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00:03:04,300 --> 00:03:10,010
What are the different materials and applications
and just introduce the process for you. We're

38
00:03:10,010 --> 00:03:15,030
also going to take you on a virtual tour of
our additive manufacturing lab at Wright state.

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00:03:15,030 --> 00:03:19,150
So you can see a little bit about what we
do in the lab

40
00:03:19,150 --> 00:03:25,230
and what our lab looks like, and then we'll
get into the application, a three D printing

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00:03:25,230 --> 00:03:31,060
in fighting COVID-19.

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00:03:31,060 --> 00:03:37,430
So our first piece is what is additive manufacturing?
So you came to this talk so you're, you're

43
00:03:37,430 --> 00:03:43,590
interested in learning about this topic. So,
let's start with our our basic definition.

44
00:03:43,590 --> 00:03:49,989
So when we say additive manufacturing, we're
referring to the general process of joining

45
00:03:49,989 --> 00:03:57,140
materials together to make some final part.
And it becomes additive manufacturing when

46
00:03:57,140 --> 00:04:03,440
you start with 3D model data. So, we
have a schematic down here at the bottom representing

47
00:04:03,440 --> 00:04:06,700
the process of how you build a part using
additive manufacturing.

48
00:04:06,700 --> 00:04:13,651
So the first thing that you start with, if
this computer aided drawing. So you create

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00:04:13,651 --> 00:04:18,449
a model on a computer with some sort of software
and whatever shape you want to print your

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00:04:18,449 --> 00:04:26,080
final parts and then
you convert that file into another file type.

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00:04:26,080 --> 00:04:32,479
It's called STL it stands for stereo-lithography file. It's just kind of an artifact

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00:04:32,479 --> 00:04:36,830
of the first process developed. It got named
after it. So an STL.

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00:04:36,830 --> 00:04:41,880
file converts the computer model into a
model of triangles.

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00:04:41,880 --> 00:04:49,020
So we've gone from a solid piece to a model
of a bunch of little triangles put together.

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00:04:49,020 --> 00:04:55,270
That model is then converted into layers.
So you turn it into these rectangular layers

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00:04:55,270 --> 00:04:59,410
and that's what's going to be printed.
So then your final part, you can kind of see,

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00:04:59,410 --> 00:05:04,669
in this last piece, this is a part printed
out on a printer, you can see the layers that

58
00:05:04,669 --> 00:05:12,169
put together your final part.
So additive manufacturing is a general definition

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00:05:12,169 --> 00:05:15,210
that's gonna mean lots of different things.
Lots of different materials that we'll talk

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00:05:15,210 --> 00:05:21,689
about in a little bit, but in general material
added layer by layer to build up our parts

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00:05:21,689 --> 00:05:28,029
and it is a relatively new manufacturing process
in terms of manufacturing processes.

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00:05:28,029 --> 00:05:36,680
The first patent inventing additive manufacturing
was in 1986 so I like to

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00:05:36,680 --> 00:05:41,949
to think that it's a new process, because
that's right about the time that I was born.

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00:05:41,949 --> 00:05:50,729
So, like to think that it's new.
So, I've been using the term additive manufacturing

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00:05:50,729 --> 00:05:55,050
that you may have noticed in the title. We
had both the terms additive manufacturing

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00:05:55,050 --> 00:06:00,889
and 3D printing. We will often
see it called layered manufacturing, solid

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00:06:00,889 --> 00:06:07,050
freeform fabrication, direct digital manufacturing,
depending how far back you're reading the

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00:06:07,050 --> 00:06:12,490
titles. The official definition is that they
all mean exactly the same thing.

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00:06:12,490 --> 00:06:17,659
So, when you see 3D printing, when you
see additive manufacturing, it's usually just

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00:06:17,659 --> 00:06:24,810

the, the author's choice of what they're referring to. If you're reading technical journal papers

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00:06:24,810 --> 00:06:29,779
a lot of times you'll see added is manufacturing because it ties it a little bit more to the

72
00:06:29,779 --> 00:06:35,899
manufacturing industry, but 3D printing could mean the same thing. So we'll use those

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00:06:35,899 --> 00:06:39,680
terms interchangeably throughout the talk.

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00:06:39,680 --> 00:06:47,689
So, before we get into why we're using 3D printing we see, we have a lot of people

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00:06:47,689 --> 00:06:54,099
out there and Laura introduced the chat feature in the beginning. So, just so, we know who's

76
00:06:54,099 --> 00:06:55,099
out there.

77
00:06:55,099 --> 00:07:00,439
If you want to type into the chat where you're from, are you a teacher? Are you here

78
00:07:00,439 --> 00:07:05,469
from from Wright State faculty are you just an interested community member? Are you a

79
00:07:05,469 --> 00:07:09,509
student? Just so we have a general idea of who's out there.

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00:07:09,509 --> 00:07:17,389

So we have some faculty members here in a
wide variety of audience and then if you have

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00:07:17,389 --> 00:07:21,430
questions, as we go along, definitely please
type them into the chat. We'll be watching

82
00:07:21,430 --> 00:07:22,439
it as we go.

83
00:07:22,439 --> 00:07:28,279
We'd like to make this a discussion, even
though we're virtually discussing as we

84
00:07:28,279 --> 00:07:30,589
go through.

85
00:07:30,589 --> 00:07:36,150
So, why would you use 3D printing or
additive manufacturing?

86
00:07:36,150 --> 00:07:41,940
These are really the big categories that we
talked about customization,

87
00:07:41,940 --> 00:07:43,949
complex designs,

88
00:07:43,949 --> 00:07:45,279
rapid prototyping,

89
00:07:45,279 --> 00:07:51,179
which is building something quickly to test
it out first and building a small number of

90
00:07:51,179 --> 00:07:56,469
parts very quickly.
So, customization would mean that you're building

91
00:07:56,469 --> 00:08:02,389
something that is unique to that one part.
So one application would be like, the dental

92
00:08:02,389 --> 00:08:08,949
industry. All of our teeth are different.
So you could 3D print dental pieces that

93
00:08:08,949 --> 00:08:15,949
are unique to the individual. Complex designs
were able to make parts that we're not able

94
00:08:15,949 --> 00:08:21,180
to make any other way.
So because of that layered approach, where

95
00:08:21,180 --> 00:08:27,150
you're building parts from scratch layer by
layer, you can build complexity into that

96
00:08:27,150 --> 00:08:32,919
piece very easily because you're building
in the part as you go along.

97
00:08:32,919 --> 00:08:42,080
Rapid prototyping. I mentioned, it's building
a part quickly, so if you're designing something

98
00:08:42,080 --> 00:08:47,600
and you want to see that part test its functions,
get it off of the computer to where you can

99
00:08:47,600 --> 00:08:52,840
actually hold it in your hand,
that's one of the big applications. And building

100
00:08:52,840 --> 00:08:59,130

a small number of parts quickly. So that's
where our COVID-19 applications come in. So

101
00:08:59,130 --> 00:09:02,940
we need these parts, we need them quickly.
We don't have time to go through a lot of

102
00:09:02,940 --> 00:09:06,740
the traditional manufacturing processes for
some of the applications.

103
00:09:06,740 --> 00:09:13,580
So, I see lots of people are chiming in letting
us know he's here. So you can can chime in

104
00:09:13,580 --> 00:09:18,220
as you want and ask questions as we go along.
If you want to know more about something specifically

105
00:09:18,220 --> 00:09:21,580
that we're talking about. Alright.

106
00:09:21,580 --> 00:09:28,320
So, let's get into a little bit of the details
and dig a little bit deeper into additive

107
00:09:28,320 --> 00:09:31,740
manufacturing and talk about all of the different
processes.

108
00:09:31,740 --> 00:09:37,490
So, there's many different processes that
you can use, many different materials that

109
00:09:37,490 --> 00:09:42,190
you can print an applications for those materials.

110
00:09:42,190 --> 00:09:49,000

Does anyone out there have a 3D printer
or have you worked with the printer maybe

111
00:09:49,000 --> 00:09:52,900
you had it in in school or you've seen it
in a library.

112
00:09:52,900 --> 00:10:00,660
So let us know if you, if you worked with
or have a 3D printer, and most likely,

113
00:10:00,660 --> 00:10:05,960
if you've done that you've worked with a material
extrusion printer.

114
00:10:05,960 --> 00:10:13,210
So, what we mean by material extrusion is
you have an filament, which is kind of like

115
00:10:13,210 --> 00:10:20,150
a plastic material that's coming into the machines
and it goes through a nozzle

116
00:10:20,150 --> 00:10:25,330
and then, if pushed through the nozzle on the
other side, and lay down onto your bed. So,

117
00:10:25,330 --> 00:10:28,630
I like to describe it, like a like a tube
of toothpaste.

118
00:10:28,630 --> 00:10:34,050
So you're pushing something through the end
of that small nozzle and it's printing it down

119
00:10:34,050 --> 00:10:40,030
onto the the bed. This is the most common
additive manufacturing process. Like I mentioned

120
00:10:40,030 --> 00:10:41,170
a lot of schools.

121
00:10:41,170 --> 00:10:45,780
I'm actually very jealous of a lot of high schools
out there now, because they have printers

122
00:10:45,780 --> 00:10:51,100
that are in their schools, and they're using
them even middle schools are being exposed

123
00:10:51,100 --> 00:10:56,230
to these technologies.
And that's what we mean by the small sizes.

124
00:10:56,230 --> 00:11:04,050
So this in the middle, this would be sitting
on a desktop on a table, a relatively small

125
00:11:04,050 --> 00:11:08,700
printer.
I see, we have lots of people out there, a

126
00:11:08,700 --> 00:11:14,660
few people with printers from high school,
you know absolutely. We definitely referred

127
00:11:14,660 --> 00:11:18,550
to the students using our printers when they go down, because

128
00:11:18,550 --> 00:11:24,530
they bring a lot of knowledge of using the
printers, and most of those were seen at the

129
00:11:24,530 --> 00:11:27,850
desktop level.
So, one of the things that we wanted to show

130
00:11:27,850 --> 00:11:32,500
you in this talk, or some of the other types
of 3D printers that are out there and

131
00:11:32,500 --> 00:11:34,310
the different size scales.

132
00:11:34,310 --> 00:11:39,620
So even within the same type of process, where
you're bringing in some material and pushing

133
00:11:39,620 --> 00:11:44,000
it through a nozzle to print your part, there's
a wide size range.

134
00:11:44,000 --> 00:11:49,970
So, we asked the desktop printers here then
they went over here as an example of a very

135
00:11:49,970 --> 00:11:55,290
large scale process, where you can see these
steps leading up, and then this entire room

136
00:11:55,290 --> 00:11:57,390
up here would be your printer.

137
00:11:57,390 --> 00:12:06,570
So, you're printing in this big environment
to where you can print huge parts and very

138
00:12:06,570 --> 00:12:13,000
strong parts. So, a, a huge range of sizes
for material extrusion printers.

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00:12:13,000 --> 00:12:22,090
So, in addition to the material extrusion
process, there are many other other processes.

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00:12:22,090 --> 00:12:26,920
There's a a standard document out there that
defined seven different processes.

141
00:12:26,920 --> 00:12:32,820
So the first one would have been material
extrusion and we've got some some fancy words

142
00:12:32,820 --> 00:12:34,990
up here from like, photo polymerization

143
00:12:34,990 --> 00:12:38,750
but we'll describe what we're talking
about

144
00:12:38,750 --> 00:12:41,940
So the two on the left,

145
00:12:41,940 --> 00:12:47,410
we have directed energy deposition and powder bed fusion. So that's switching a little bit

146
00:12:47,410 --> 00:12:52,070
from the plastic filaments that are going
in to metal parts.

147
00:12:52,070 --> 00:12:59,530
So, here, you're actually using a heat source,
a high energy heat source, in order to melt

148
00:12:59,530 --> 00:13:03,480
metal as it's coming in, and form into a solid
part.

149
00:13:03,480 --> 00:13:08,070
So, directed energy deposition would be really
close to a process that a lot of you have

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00:13:08,070 --> 00:13:14,860
probably heard of called welding. So welding
is heating up material and laying it down.

151
00:13:14,860 --> 00:13:19,360
So these metal processes are welding over
and over and over again to build up an entire

152
00:13:19,360 --> 00:13:25,060
part.
And powder bed fusion is a little different than the

153
00:13:25,220 --> 00:13:30,160
welding processes,
because it actually has an entire layer of

154
00:13:30,160 --> 00:13:31,200
powder,

155
00:13:31,200 --> 00:13:37,360
an entire bed to where you're just selectively
melting what you want on that particular layer

156
00:13:37,360 --> 00:13:41,220
to build up your total part.

157
00:13:41,220 --> 00:13:47,810
There are other plastics or polymer processes,
other than the material extrusion process

158
00:13:47,810 --> 00:13:52,100
and that would be the top to here in the middle
and on the right.

159
00:13:52,100 --> 00:13:57,630
Called Vat Photo polymerization, quite a mouthful,
and material jetting.

160

00:13:57,630 --> 00:14:05,851
So, this process in the middle of photo polymerization
is a fancy way of saying that when this material

161
00:14:05,851 --> 00:14:10,670
is exposed to light, it changes from a liquid
to a solid.

162
00:14:10,670 --> 00:14:18,190
So, you have this vat of liquid and then
there's a particular wavelength of light that

163
00:14:18,190 --> 00:14:22,930
shines on the liquid, and it causes it to
change from a liquid to the solid. So as

164
00:14:22,930 --> 00:14:24,470
that change occurs,

165
00:14:24,470 --> 00:14:30,400
now you can pull a solid part out of this vat of
liquid.

166
00:14:30,400 --> 00:14:38,470
So this one in process is really interesting
to watch because it's actually moving in this

167
00:14:38,470 --> 00:14:45,260
top piece of pulling up and you're pulling
the solid part out of this thin layer liquid

168
00:14:45,260 --> 00:14:47,620
bellow.

169
00:14:47,620 --> 00:14:52,190
Material uses the same conversion from solid
to liquid

170

00:14:52,190 --> 00:14:58,410
but rather than having the big vat of material,
it's spraying that same material just when

171
00:14:58,410 --> 00:15:06,270
it's supposed to be. So you can see the parts
are separate out and this light over here,

172
00:15:06,270 --> 00:15:13,480
it's processing symmetry.
Binder jetty has moved down on the right is

173
00:15:13,480 --> 00:15:18,470
another process where you're getting, or you're
spraying a liquid, but you can think of that

174
00:15:18,470 --> 00:15:23,620
liquid as glue.
So you have a a big container of of powder

175
00:15:23,620 --> 00:15:28,820
and
you're gluing together what you want on that

176
00:15:28,820 --> 00:15:34,370
particular layer,
and then continuing to build up later by layer.

177
00:15:34,370 --> 00:15:41,940
And then another process would be sheet lamination
where you have a sheet of material

178
00:15:41,940 --> 00:15:47,860
so your layer now is just a piece a sheet
that you're laying on top of one another.

179
00:15:47,860 --> 00:15:52,500
The picture I have here is a metal sheets
that are being put together but then there's

180
00:15:52,500 --> 00:15:54,120
other processes where it's paper.

181
00:15:54,120 --> 00:15:59,540
So, it's just standard A-4 paper where
the paper is glued together with some sort

182
00:15:59,540 --> 00:16:07,500
of adhesive bring in a traditional printer
and you can print color on that part.

183
00:16:07,500 --> 00:16:16,000
So, we had a comment about the SLA printing so
the, that polymerization process was actually the first

184
00:16:16,000 --> 00:16:17,720
one that was invented.

185
00:16:17,720 --> 00:16:26,360
So that was the one that was invented in an
86 in L. A. is a.

186
00:16:26,360 --> 00:16:33,720
particular process in this category. The SLA
name is trademarked by a company.

187
00:16:33,720 --> 00:16:38,810
So the official definition for the category
could be the trademark name but if you see

188
00:16:38,810 --> 00:16:47,779
the term SLA, then that would be within the
category.

189
00:16:47,779 --> 00:16:53,250
So all of these different processes produce
parts in different ways, they use different

190
00:16:53,250 --> 00:16:54,250
materials.

191
00:16:54,250 --> 00:16:59,710
So there's really a wide range of applications
that you can use for additive manufacturing.

192
00:16:59,710 --> 00:17:06,760
The two, biggest categories that you'll see
our plastics and metals. So, let's start on

193
00:17:06,760 --> 00:17:08,510
the plastics side.

194
00:17:08,510 --> 00:17:16,539
So we mentioned desktop printers, so you could
print out little kind of trinket, desk decorations.

195
00:17:16,539 --> 00:17:21,259
If you have something, you know, maybe a small
clip or something that broke in your house,

196
00:17:21,259 --> 00:17:24,789
you could print out a piece like that.

197
00:17:24,789 --> 00:17:32,110
And these are the really common printer for
yours you're pretty small polymer parts. The

198
00:17:32,110 --> 00:17:37,789
big printer that I showed you, on the material
extrusion page, actually printed this car.

199
00:17:37,789 --> 00:17:41,659
So,
this is a full size Shelby Cobra,

200
00:17:41,659 --> 00:17:46,619
it was printed for some anniversary of Shelby,

201
00:17:46,619 --> 00:17:55,070
and all these body pieces were printed in that
machine and then they were polished and painted

202
00:17:55,070 --> 00:17:56,340
to look really nice.

203
00:17:56,340 --> 00:18:02,320
Then put together with an engine and all the
other components of the car, and the car drives

204
00:18:02,320 --> 00:18:12,070
around. So printed a full sized model of the
car. The other process is like the SLA

205
00:18:12,070 --> 00:18:21,249
that photo polymerization processes, these dental
molds. So if anybody out there wears the braces

206
00:18:21,249 --> 00:18:22,249
alternative or

207
00:18:22,249 --> 00:18:29,970
retainers. The teeth mold for the retainers
are actually printed. So you can now go to

208
00:18:29,970 --> 00:18:34,850
a dentist and they can scan your mouth and
get a mold or get a map of your teeth

209
00:18:34,850 --> 00:18:36,970
put that into a computer model,

210
00:18:36,970 --> 00:18:40,039

do the STL layer model conversion,

211
00:18:40,039 --> 00:18:47,019
and then print out this piece mode and then
they take this clear plastic piece,

212
00:18:47,019 --> 00:18:53,860
that is the actual retainer and mold it over
the teeth to then have it be your final final

213
00:18:53,860 --> 00:19:02,140
piece. You can also print full color models, so good educational
example of seeing all of the pieces that go

214
00:19:02,140 --> 00:19:03,140
into the

215
00:19:03,140 --> 00:19:08,639
human brain and different different
pathways for

216
00:19:08,639 --> 00:19:16,159
for veins and and arteries and that can all
be printed in to be a nice visual.

217
00:19:16,159 --> 00:19:24,389
And then a recent application, last year at the Met
gala in New York works there was a printed

218
00:19:24,389 --> 00:19:27,820
dress. So this was a collaboration between.

219
00:19:27,820 --> 00:19:30,549
I believe Zac Posen and GE Additive.

220
00:19:30,549 --> 00:19:35,730
So one of the industrial additive processes,

221
00:19:35,730 --> 00:19:42,269
they took inspiration from a rose opening
and created computer models of those rose

222
00:19:42,269 --> 00:19:48,690
petals and then we're able to print them out
and really get the exact structure and flow

223
00:19:48,690 --> 00:19:50,299
that they wanted

224
00:19:50,299 --> 00:19:51,299
on this,

225
00:19:51,299 --> 00:19:53,990
this plastic polymer dress.

226
00:19:53,990 --> 00:20:01,799
So, we're really spanning all sorts of applications
from desktop printers to dental, to fashion,

227
00:20:01,799 --> 00:20:06,950
to cars, to automotive all sorts of applications
for plastics.

228
00:20:06,950 --> 00:20:17,379
And then if we move to metals, we have aerospace
applications, dental application printing

229
00:20:17,379 --> 00:20:27,149
a unique to have again aesthetic piece to it
nickel applications. So, these were printing

230
00:20:27,149 --> 00:20:33,919
complex geometries with really advanced capabilities.

231
00:20:33,919 --> 00:20:38,730

And then if we move into some of the nontraditional
materials and applications,

232
00:20:38,730 --> 00:20:40,520
there are ceramics again,

233
00:20:40,520 --> 00:20:47,239
these could be used in industrial applications
like aerospace where you need something that

234
00:20:47,239 --> 00:20:49,960
handles a very high temperature.

235
00:20:49,960 --> 00:20:54,549
There's biological materials where they're
working to be able to print

236
00:20:54,549 --> 00:21:02,350
this is actually a vascular heart, so they
were able to print cells and get them to join

237
00:21:02,350 --> 00:21:06,690
together and the appropriate way to form organ.

238
00:21:06,690 --> 00:21:14,289
There are printing concrete where you're
laying down you can see the layers of the

239
00:21:14,289 --> 00:21:21,200
concrete in this wall to where they've actually
printed houses. Printed electronics.

240
00:21:21,200 --> 00:21:29,150
Dr Mian does some research in printing electronics
where your printing is conductive ink to be

241
00:21:29,150 --> 00:21:33,299
able to form a complex electronic structure.

242
00:21:33,299 --> 00:21:40,289
And then one of my favorite applications would
be printing of food. So you can make

243
00:21:40,289 --> 00:21:41,289
very

244
00:21:41,289 --> 00:21:48,980
pretty meals to eat. You can print chocolate
this up here on the right is a Hershey printer

245
00:21:48,980 --> 00:21:54,570
where they're actually printing out unique
shapes of chocolate. And then the bottom one

246
00:21:54,570 --> 00:21:55,570
is

247
00:21:55,570 --> 00:21:56,570
NASA.

248
00:21:56,570 --> 00:22:02,149
I was looking at the ability to print things
like pizza. So, that the astronauts get a

249
00:22:02,149 --> 00:22:06,409
little bit more exciting food to eat on their
missions.

250
00:22:06,409 --> 00:22:13,559
So all sorts of different materials and applications
I have my and more statement down here,

251
00:22:13,559 --> 00:22:15,539
because we could,

252

00:22:15,539 --> 00:22:16,539
you know,

253
00:22:16,539 --> 00:22:21,509
talk for an entire semester in a class on
all these different applications of

254
00:22:21,509 --> 00:22:25,850
3D printing and the different materials that
you can use.

255
00:22:25,850 --> 00:22:34,679
Alright, so now we're gonna take you on just
a brief virtual tour. So we're going to take

256
00:22:34,679 --> 00:22:41,740
you to are additive manufacturing lab on campus
at Wright State.

257
00:22:41,740 --> 00:22:54,860
So, this lab is in the Russ engineering center
on campus, and we established the lab in last

258
00:22:54,860 --> 00:22:55,860
summer.

259
00:22:55,860 --> 00:22:57,600
2017,

260
00:22:57,600 --> 00:22:59,230
prior to that we had printers,

261
00:22:59,230 --> 00:23:02,619
we've had printers for quite a long time,

262
00:23:02,619 --> 00:23:07,102
but we've brought them all together into a
lab to where we can really emphasized the

263
00:23:07,102 --> 00:23:13,259
different applications and get a lot more
people to be able to use the printers and

264
00:23:13,259 --> 00:23:17,480
take advantage of the capabilities that were
spread throughout campus.

265
00:23:17,480 --> 00:23:21,269
So we have several different printers that
print with the plastics. We have a couple

266
00:23:21,269 --> 00:23:26,299
of the desktop printers. We also have a few
that are a little higher quality, more industrial

267
00:23:26,299 --> 00:23:27,299
type printers.

268
00:23:27,299 --> 00:23:33,499
So this is a video of one of those printers
printing it is sped up a little bit. So you

269
00:23:33,499 --> 00:23:38,739
can see it process a little bit more but if
you looked really close, you could see little

270
00:23:38,739 --> 00:23:43,989
pads of plastics that are being laid down
as that

271
00:23:43,989 --> 00:23:48,700
piece moves around. And then this is our metal
printer.

272
00:23:48,700 --> 00:23:55,389
That's a recent addition to the lab and this

uses a high powered laser beam to melt the

273
00:23:55,389 --> 00:24:01,450
material and turn it from a powder into a solid piece.

274
00:24:01,450 --> 00:24:05,779
And you can see, it almost looks like there's two lasers moving at different parts. It's

275
00:24:05,779 --> 00:24:10,690
just because it's moving so fast that the camera on your eye can't keep up with it.

276
00:24:10,690 --> 00:24:17,159
So, it really is just one high powered moving very, very quickly and that produces solid

277
00:24:17,159 --> 00:24:23,919
metal parts. And this is our, our ink printer, where you could print out printed electronics.

278
00:24:23,919 --> 00:24:30,799
So we do several different pieces of research and this is many different faculty members.

279
00:24:30,799 --> 00:24:32,960
We're doing development of the processes,

280
00:24:32,960 --> 00:24:40,890
the materials, looking at modeling different structures and testing how they perform and

281
00:24:40,890 --> 00:24:41,890
seeing how the,

282
00:24:41,890 --> 00:24:47,090
the process affects the material behavior

and watching things break,

283
00:24:47,090 --> 00:24:48,730
which is always fun.

284
00:24:48,730 --> 00:24:56,509
We also do teachings and added in manufacturing.
We have a class, this past semester, between

285
00:24:56,509 --> 00:25:00,440
two sections. We have seventy students. We
have lots of capstone senior design applications

286
00:25:00,440 --> 00:25:03,239
where they're doing printing of prototyping
parts,

287
00:25:03,239 --> 00:25:06,840
they're doing added manufacturing research.

288
00:25:06,840 --> 00:25:12,470
We also do a lot of outreach where we take
our printers to places, and we do printing

289
00:25:12,470 --> 00:25:20,419
demonstrations for kids, and we also bring
people into the lab and show them the facility.

290
00:25:20,419 --> 00:25:25,520
So, this is your virtual tour of the lab.
But I definitely want to encourage all of

291
00:25:25,520 --> 00:25:31,119
you that if you would like an in person tour
to get in contact with us when we can all

292
00:25:31,119 --> 00:25:34,499
come up back on campus and we'd be happy to

show you the lab.

293
00:25:34,499 --> 00:25:46,600
I'm happy to show you a little more of the
capability. So if we come back to our

294
00:25:46,600 --> 00:25:58,539
tour, this is just one slide on
our added manufacturing lab.

295
00:25:58,539 --> 00:26:06,580
So, like, I mentioned, it was established
in 2019 in the Russ engineering

296
00:26:06,580 --> 00:26:15,379
center. You can print with different materials, we have plastic
printers, we have metal printers, we have ink

297
00:26:15,379 --> 00:26:18,889
printers. You can definitely come to the lab
and see the facility.

298
00:26:18,889 --> 00:26:21,409
Also,
if you're interested in collaborating,

299
00:26:21,409 --> 00:26:25,940
if you that you think would be a good applications,

300
00:26:25,940 --> 00:26:27,769
were added in manufacturing,

301
00:26:27,769 --> 00:26:34,109
come talk to us and you can come and do printing
iIf you're out there as a community member,

302
00:26:34,109 --> 00:26:37,260
we also collaborate with members of the community.

303
00:26:37,260 --> 00:26:42,109
We've built parts for high school students
where they needed it for, like, a robotics

304
00:26:42,109 --> 00:26:49,770
competition and we definitely are interested
in talking with you. So so please, please,

305
00:26:49,770 --> 00:26:51,799
let us know.

306
00:26:51,799 --> 00:26:59,500
And so we have a question about the, the laser
cutter. So, I did forget to mention that not strictly

307
00:26:59,500 --> 00:27:01,190
an additive process.

308
00:27:01,190 --> 00:27:07,840
We like to lump it in with the sheet lamination
process to where you could cut out a bunch

309
00:27:07,840 --> 00:27:12,259
of different sheets and then stack them together.

310
00:27:12,259 --> 00:27:21,070
So, this cutter is a fairly robust cutter.
So, they've used it to cut like balsa wood type

311
00:27:21,070 --> 00:27:22,070
thickness.

312
00:27:22,070 --> 00:27:28,850
So not just cardboard materials, but also
also wood type materials. So I'm not sure

313

00:27:28,850 --> 00:27:41,169
of an exact thickness, but if you want to
reach out, we can get that information to

314
00:27:41,169 --> 00:27:42,230
you.

315
00:27:42,230 --> 00:27:50,639
So, if we, so, for the plastic printing,
I believe our so we have a question about

316
00:27:50,639 --> 00:27:54,429
what the bed size for the plastic printing
is.

317
00:27:54,429 --> 00:28:01,763
I believe our largest is ten inches. I don't
know if any of the other panelists know the

318
00:28:01,763 --> 00:28:03,509
numbers off the top of their heads.

319
00:28:03,509 --> 00:28:12,299
We don't have any huge plastic printers in
our lab. They're on the ten to twelve inch square

320
00:28:12,299 --> 00:28:18,440
platform size. None of the car
printers

321
00:28:18,440 --> 00:28:19,470
unfortunately.

322
00:28:19,470 --> 00:28:29,519
But our, so Dr. Mian chimed in on the chat,
it's twelve by twelve inches for our

323
00:28:29,519 --> 00:28:32,490

platform, but it is a relatively high quality.

324
00:28:32,490 --> 00:28:45,139
So you can get a decently large piece, which
is a good quality of print.

325
00:28:45,139 --> 00:28:50,529
So there are lots of challenges with additive
manufacturing as well. So, we've talked about

326
00:28:50,529 --> 00:28:57,890
the benefits and the cool applications, however,
to get to those cool applications

327
00:28:57,890 --> 00:29:04,159
you have to really understand the process
and what's it what it's doing and how to make

328
00:29:04,159 --> 00:29:08,169
sure that you're creating a quality part repeatedly.

329
00:29:08,169 --> 00:29:13,810
So you want to be able to print the same thing.
If you print one on Monday and print one on

330
00:29:13,810 --> 00:29:15,179
Friday,

331
00:29:15,179 --> 00:29:21,190
you wanna make sure that those parts are good.
Build speed and also a challenge. You hear

332
00:29:21,190 --> 00:29:27,399
us talk a lot about being able to print parts
fast. Fast is a relative term.

333
00:29:27,399 --> 00:29:36,639
You can still take days to print a part. I've

seen parts that, you know, take up to two

334
00:29:36,639 --> 00:29:41,509
weeks to print. If you're really complex and
at a small scale that you're trying to build

335
00:29:41,509 --> 00:29:42,509
a part.

336
00:29:42,509 --> 00:29:45,020
You know, maybe it's only about this big,
but it still takes that long because of the

337
00:29:45,020 --> 00:29:51,500
complexity. We do a lot of research and material
and process development, particularly with

338
00:29:51,500 --> 00:29:55,669
the material science department and Dr shove
often looking at how

339
00:29:55,669 --> 00:30:04,759
can we create materials that really allow
us to take advantage of this additive benefit

340
00:30:04,759 --> 00:30:08,739
and then understanding how those are going
to perform. Making sure that they're not going

341
00:30:08,739 --> 00:30:12,450
to break prematurely in our intended

342
00:30:12,450 --> 00:30:15,019
applications.

343
00:30:15,019 --> 00:30:16,019
And so,

344
00:30:16,019 --> 00:30:21,470
a lot of these challenges feed directly into
the next part of our discussion where we think

345
00:30:21,470 --> 00:30:25,240
about the applications that are being used
for COVID-19

346
00:30:25,240 --> 00:30:30,690
and 3D printing because these
are potentially impactful applications.

347
00:30:30,690 --> 00:30:35,570
But we need to make sure their quality and repeatability
and understanding their performance.

348
00:30:35,570 --> 00:30:44,269
So, if any of you were following along and
do in mid March, as we were watching, what

349
00:30:44,269 --> 00:30:52,259
was going on in Europe, and then you may have
seen this valve pop up in your in your news.

350
00:30:52,259 --> 00:30:55,320
So,
there was a hospital in Italy,

351
00:30:55,320 --> 00:30:59,659
and they had an urgent need where they ran
out of these valves

352
00:30:59,659 --> 00:31:09,000
here. This one on the right is the original
from the traditionally manufactured process.

353
00:31:09,000 --> 00:31:13,989
And they weren't able to use the ventilators that

they had, because they didn't have these belts.

354
00:31:13,989 --> 00:31:20,159
So, there was a local, 3D printing company
where they, they print for living and the

355
00:31:20,159 --> 00:31:24,859
hospital got in contact with this company
that the company saw the need.

356
00:31:24,859 --> 00:31:30,249
And so, they brought a printer to the hospital,
they reverse engineered the part and printed

357
00:31:30,249 --> 00:31:35,220
test parts out in plastic. So that's what
you see up here on the left. And so they were

358
00:31:35,220 --> 00:31:37,570
able to print a part was functional

359
00:31:37,570 --> 00:31:43,169
and it was serving the urgent need that the
hospital had.

360
00:31:43,169 --> 00:31:44,860
The plastic part,

361
00:31:44,860 --> 00:31:49,840
was a little lower quality than they really
needed,

362
00:31:49,840 --> 00:31:54,619
but they were able to reach out to another
local company that had a different additive

363
00:31:54,619 --> 00:32:01,649
process that produced a more dense and higher

quality part called selective laser centering

364
00:32:01,649 --> 00:32:06,140
and they were able to print all the parts
here on the bottom.

365
00:32:06,140 --> 00:32:08,289
So we had a question about how quickly

366
00:32:08,289 --> 00:32:11,950
this happened and how long the reverse engineering
took.

367
00:32:11,950 --> 00:32:19,249
I don't think they gave specific numbers in
in the articles, but just based on the the

368
00:32:19,249 --> 00:32:25,239
timeline of how everything happened, this
was within a week.

369
00:32:25,239 --> 00:32:32,009
So, they are taking measurements, maybe taking
scans off of the original design and and replicating it.

370
00:32:32,009 --> 00:32:37,279
There were also some articles that talked
about how the original manufacturer was going

371
00:32:37,279 --> 00:32:41,409
to sue them.
I think most of those were attracted to where,

372
00:32:41,409 --> 00:32:44,669
in an urgent situation like this,

373
00:32:44,669 --> 00:32:52,389
they were able to modify the design and

work with that original manufacturer to make

374
00:32:52,389 --> 00:33:00,049
sure that they weren't infringing on patents
and were able to serve the urgent need.

375
00:33:00,049 --> 00:33:04,590
And so that's one of the key things when we
think about the COVID-19 applications

376
00:33:04,590 --> 00:33:10,759
is the urgent need versus making sure we have
a robustly engineered part.

377
00:33:10,759 --> 00:33:16,659
Because the timeline of a week is not typically
the timeline for designing something in engineering.

378
00:33:16,659 --> 00:33:21,379
It typically takes a much longer time than
that where you're doing iterations, your

379
00:33:21,379 --> 00:33:25,499
testing, you're testing multiple pieces, making
sure they're good over time.

380
00:33:25,499 --> 00:33:28,340
So, one of the key things with this application
is

381
00:33:28,340 --> 00:33:34,669
that they were single use only part. So there
really wasn't a way to sterilize them from

382
00:33:34,669 --> 00:33:39,200
one person to another.

383
00:33:39,200 --> 00:33:46,419

So, as soon as that article came out,

384
00:33:46,419 --> 00:33:51,050
many other people started thinking about.
Well, what else could we 3D print? What

385
00:33:51,050 --> 00:33:57,869
else could we could we make? Could we use
printing to to solve problem?

386
00:33:57,869 --> 00:34:03,989
So the makers as you call them started
working, they started designing masks, they

387
00:34:03,989 --> 00:34:05,389
started designing face shields,

388
00:34:05,389 --> 00:34:10,550
they started designing hooks that you could
use so you didn't have to touch a door handle

389
00:34:10,550 --> 00:34:17,669
to open the door handle and these articles
and part started kind of flooding the Internet

390
00:34:17,669 --> 00:34:20,250
of well, we could print this,

391
00:34:20,250 --> 00:34:24,240
we could print this, we can print print all
of these shapes. And so the good thing with

392
00:34:24,240 --> 00:34:29,070
additive manufacturing is that you can print all
of these shapes, you can print these complex

393
00:34:29,070 --> 00:34:32,080
geometries. You can print these structures.

394
00:34:32,080 --> 00:34:38,970
However, the question as engineers, we have
to ask, Well, what should be printed? What

395
00:34:38,970 --> 00:34:40,300
is 3D printing really

396
00:34:40,300 --> 00:34:48,750
the best application for? And can we make sure
that the designs are safe when we're printing

397
00:34:48,750 --> 00:34:52,780
something like a door handle hook if it fails,

398
00:34:52,780 --> 00:34:55,409
it's really not that big of a deal,

399
00:34:55,409 --> 00:35:00,210
but if we're printing something like a mask
for a hospital worker,

400
00:35:00,210 --> 00:35:01,210
if it fails,

401
00:35:01,210 --> 00:35:05,360
it's a big deal and could potentially impacts on life.

402
00:35:05,360 --> 00:35:10,740
So we have to ensure that the, the designs
in the parts are safe.

403
00:35:10,740 --> 00:35:17,060
So a lot of those challenges that we talked
about, kind of come back in the construct

404
00:35:17,060 --> 00:35:18,820

of COVID-19.

405
00:35:18,820 --> 00:35:26,590
So, we need to make sure that the design that's
produced is a high quality design, that it's

406
00:35:26,590 --> 00:35:33,400
going to make sure that after you print that
design, you have a good quality part. I mentioned

407
00:35:33,400 --> 00:35:35,600
that
our printer in the lab is a little higher

408
00:35:35,600 --> 00:35:40,010
quality than some of the printers that you
may have at home, or at your high school.

409
00:35:40,010 --> 00:35:46,490
So if you print a part in the lab versus printing
a part at home, it's gonna be a different

410
00:35:46,490 --> 00:35:47,490
quality,

411
00:35:47,490 --> 00:35:53,140
and it may not serve the function that it's
intended by using different printers. So that

412
00:35:53,140 --> 00:35:55,540
goes into the actual function of the part.

413
00:35:55,540 --> 00:36:00,570
Is it performing the way that it's supposed
to? Just because it looks like it's supposed

414
00:36:00,570 --> 00:36:06,070
to doesn't mean it's going to work like it's

supposed to. And then some issues with cleanliness

415
00:36:06,070 --> 00:36:10,210
and being able to sanitize if it's a component
that

416
00:36:10,210 --> 00:36:12,170
needs to be sanitized.

417
00:36:12,170 --> 00:36:17,620
A lot of these parts, maybe the material will
dissolve under certain certain solvents. So

418
00:36:17,620 --> 00:36:23,980
you have to make sure you're using the appropriate
ability to clean. And then there's the legal

419
00:36:23,980 --> 00:36:26,370
issues, like copyright and liability.

420
00:36:26,370 --> 00:36:31,950
So, if you pull a design from the Internet,
and you print it, and you give it to someone,

421
00:36:31,950 --> 00:36:33,810
and it hurts them,

422
00:36:33,810 --> 00:36:37,830
who's that fault? Is it the person that printed
it? Is it the person that created the design?

423
00:36:37,830 --> 00:36:41,170
And so there's a lot of issues that have to
be resolved there.

424
00:36:41,170 --> 00:36:47,150
I'm an engineer, not a lawyer, so we're not
gonna talk anymore about those issues, because

425
00:36:47,150 --> 00:36:49,040
I'm not the one to answer those questions.

426
00:36:49,040 --> 00:36:54,750
So we can talk about the, the designs and
the parts in the quality of the prints and

427
00:36:54,750 --> 00:36:58,920
One other piece is just making. Sure, that
3D printing is the right tool for the

428
00:36:58,920 --> 00:36:59,920
job.

429
00:36:59,920 --> 00:37:05,090
So if you think about everything in the construct
of 3D printing, it's that phrase

430
00:37:05,090 --> 00:37:09,660
that when you're a hammer, everything looks
like a nail. So, you can print everything

431
00:37:09,660 --> 00:37:17,430
you can can create the geometry, but is it
the best way to do it?

432
00:37:17,430 --> 00:37:23,260
So,
we had a question about a microbial filament.

433
00:37:23,260 --> 00:37:30,130
So I've read a little bit about this where
they're essentially taking a plastic and they're

434
00:37:30,130 --> 00:37:33,920
putting brass is the particular

435
00:37:33,920 --> 00:37:43,550
material that the question is about into the
filament as a material that that's anti microbial.

436
00:37:43,550 --> 00:37:47,810
I don't, I don't have a good answer to that
just because I don't think there's enough

437
00:37:47,810 --> 00:37:55,680
data or I've not read enough data on whether it will work or not. But I

438
00:37:55,680 --> 00:37:57,160
think it's an interesting application.

439
00:37:57,160 --> 00:38:02,900
I don't know if any of the other panelists
have read anything about the, the brass filaments,

440
00:38:02,900 --> 00:38:09,310
or I think copper is another material that
people are starting to look at as a material

441
00:38:09,310 --> 00:38:12,860
that will help fight bacteria.

442
00:38:12,860 --> 00:38:29,390
So, we have another, we have a chime in, from
one of our panel members about copper and

443
00:38:29,390 --> 00:38:31,790
silver are both anti microbial.

444
00:38:31,790 --> 00:38:38,971
So potentially looking at applications where
you're using brass or copper, silver, as part

445
00:38:38,971 --> 00:38:44,500

of the print could help with some of
the biological issues.

446
00:38:44,500 --> 00:38:54,690
We have another question about printing and
scanning and creating models. So some of these

447
00:38:54,690 --> 00:39:00,950
models, if you're really trying to build a
complex part, become very complicated.

448
00:39:00,950 --> 00:39:06,070
So creating the model is a difficult thing.

449
00:39:06,070 --> 00:39:14,800
So, there is some research into scanning and
looking at methods to create the models from

450
00:39:14,800 --> 00:39:17,800
the parts and you can do that.

451
00:39:17,800 --> 00:39:25,660
So you can create a ticket 3D scan and
turn it into a a final model.

452
00:39:25,660 --> 00:39:28,130
So,

453
00:39:28,130 --> 00:39:33,840
as all of these designs and parts for

454
00:39:33,840 --> 00:39:35,390
COVID-19 started flooding the market,

455
00:39:35,390 --> 00:39:39,320
some of the national organizations said,

456

00:39:39,320 --> 00:39:44,780
we need to come up with a plan we need to
come up with a structure in order to get people

457
00:39:44,780 --> 00:39:49,600
what they need but make sure they're robust
engineering solutions. So there's a organization

458
00:39:49,600 --> 00:39:55,420
called America Makes where it is a,

459
00:39:55,420 --> 00:40:00,160
a private public partnership, where a bunch
of companies and universities and government

460
00:40:00,160 --> 00:40:07,760
organizations or members. And so they organized
the structure where they're taking in the needs

461
00:40:07,760 --> 00:40:08,760
from the community.

462
00:40:08,760 --> 00:40:14,070
What do they need, the design. They're coming
from everywhere in the world and capabilities

463
00:40:14,070 --> 00:40:16,580
of printing,

464
00:40:16,580 --> 00:40:22,320
and bringing them all into one place to where
the design can then be tested, that can be

465
00:40:22,320 --> 00:40:23,320
reviewed,

466
00:40:23,320 --> 00:40:29,820
what do they need, FDA clearance. Tested by

the for or clinical ability and also coordinating

467
00:40:29,820 --> 00:40:35,700
with the National Institute of health in order
to provide design that have been tested.

468
00:40:35,700 --> 00:40:44,720
And, you know, that the designs are good,
and they have print quality tied to those

469
00:40:44,720 --> 00:40:46,680
parts.

470
00:40:46,680 --> 00:40:50,330
So some of the different things that you'll
see this website,

471
00:40:50,330 --> 00:40:51,330
if you're out there,

472
00:40:51,330 --> 00:40:52,330
and you have a printer,

473
00:40:52,330 --> 00:40:53,330
and you won't want to print things,

474
00:40:53,330 --> 00:41:01,810
this is the website where all of these designs
are housed that have been approved for use

475
00:41:01,810 --> 00:41:02,810
per week.

476
00:41:02,810 --> 00:41:11,800
They see about fifteen thousand visitors so
a lot of people are finding these parts.

477

00:41:11,800 --> 00:41:18,390
Doing only one one time,

478
00:41:18,390 --> 00:41:19,640
if you want to,

479
00:41:19,640 --> 00:41:26,080
even with your microphone from one of our
our panel members about potential health issues

480
00:41:26,080 --> 00:41:31,110
with the the microbial anti microbial materials.

481
00:41:31,110 --> 00:41:32,110
So,

482
00:41:32,110 --> 00:41:33,110
yes,

483
00:41:33,110 --> 00:41:37,930
there's a lot of testing that still needs
to be done,

484
00:41:37,930 --> 00:41:45,450
But a promising promising Nano micro composites
seem to be there.

485
00:41:45,450 --> 00:41:58,660
So some tests needs to be done before it can
be used completly. This is very good point.

486
00:41:58,660 --> 00:42:06,810
So, we have Dr. Mian also the model on this
page of some of the face shields that we printed

487
00:42:06,810 --> 00:42:13,360
in in the lab. This is probably the top application
that you'll see out there for 3D printing

488
00:42:13,360 --> 00:42:14,860
COVID-19

489
00:42:14,860 --> 00:42:21,800
where you print the headband piece.
So, it's this white stuff here and then attach

490
00:42:21,800 --> 00:42:24,860
a clear film to the front.

491
00:42:24,860 --> 00:42:32,590
And so you can use, like, transparent material
or file dividers. Very easily accessible.

492
00:42:32,590 --> 00:42:40,610
We found a bunch in a storage room on campus
that could be attached to the front of these

493
00:42:40,610 --> 00:42:41,610
face shields.

494
00:42:41,610 --> 00:42:48,550
And that protects the traditional PPE that the
person may be wearing and they're recommended

495
00:42:48,550 --> 00:42:52,580
to where it for an extended period of time
now. So it keeps it from being soiled

496
00:42:52,580 --> 00:43:00,710
and it allows it to be a little safer to use
for an extended period of time. These can

497
00:43:00,710 --> 00:43:04,670
also be made in some other ways they're people
that are looking for cutting or other ways

498
00:43:04,670 --> 00:43:07,000
to assemble the face Shields.

499
00:43:07,000 --> 00:43:13,450
But I think it was relatively comfortable.
I never actually put it on, but I know Dr

500
00:43:13,450 --> 00:43:18,910
Mian a Dr. Srinivasan did so you
can let us know how the fit was.

501
00:43:18,910 --> 00:43:25,140
It was perfect actually, especially for my
head and the one that we

502
00:43:25,140 --> 00:43:35,330
created was perfect and it's, I mean, it's
flexible, so it will it should should fit to anybody.

503
00:43:35,330 --> 00:43:44,800
This is the material he says he's actually
The same design fit me too. So yeah, I

504
00:43:44,800 --> 00:43:47,330
guess it, it works.

505
00:43:47,330 --> 00:43:51,340
So,
there are lots of different companies and

506
00:43:51,340 --> 00:43:57,110
people in their homes that are printing these
parts again on that NIH website there's

507
00:43:57,110 --> 00:44:02,190
several different model for this,

508

00:44:02,190 --> 00:44:03,900
the different types of a shield,

509
00:44:03,900 --> 00:44:04,900
band,

510
00:44:04,900 --> 00:44:08,600
so it can be printed and instruction for assembling them
and providing the,

511
00:44:08,600 --> 00:44:11,260
the additional pieces.

512
00:44:11,260 --> 00:44:18,550
So, face shields are a great application for additive
manufacturing. One of the big deficits right

513
00:44:18,550 --> 00:44:25,160
now is is masks, but there's a lot of challenges
associated with using additive manufacturing

514
00:44:25,160 --> 00:44:27,370
to do masks.

515
00:44:27,370 --> 00:44:33,430
One of the main things is the fit on your
face. So, if you think of a plastic piece,

516
00:44:33,430 --> 00:44:40,210
and you're putting that on as a mask, there's
gonna be gaps and potential contaminants could

517
00:44:40,210 --> 00:44:41,750
get in.

518
00:44:41,750 --> 00:44:47,260
So really, the general guidance right now
is no to creating something that's like an

519
00:44:47,260 --> 00:44:48,670
M95 mask.

520
00:44:48,670 --> 00:44:54,430
However, it's yes to creating base coverings,
maybe equivalent to the masks that are being

521
00:44:54,430 --> 00:44:59,830
sewn out of fabric to where you're covering
your face and you're protecting others, but

522
00:44:59,830 --> 00:45:01,700
it's not necessarily protecting you.

523
00:45:01,700 --> 00:45:09,080
So these are just some images that I pulled
from the NIH website of the proof designs to

524
00:45:09,080 --> 00:45:13,500
where it maybe not a very good sewer. And
you haven't been able to create a masks.

525
00:45:13,500 --> 00:45:22,730
You just cut out the fabric and clip it together
and then you have a face covering.

526
00:45:22,730 --> 00:45:31,680
And then some more robust mask that make us we
putting an actual filter in to be able to breath through

527
00:45:31,680 --> 00:45:35,640
you know, maybe having a little more protection,
but it's still not a equivalent to

528
00:45:35,640 --> 00:45:41,950
an M95. you don't have that that good sealing
around the space for a respirator.

529
00:45:41,950 --> 00:45:47,660
There is a challenge that happened this past
week since we're talking about rapid design,

530
00:45:47,660 --> 00:45:53,100
they announced it and they collected the designs
one week later for an open source mask design

531
00:45:53,100 --> 00:45:58,230
challenge and they're supposed to announce
the top designs on may 11th.

532
00:45:58,230 --> 00:46:03,940
So, they're evaluating a bunch of mass designs
that people have submitted to see how they

533
00:46:03,940 --> 00:46:04,940
work.

534
00:46:04,940 --> 00:46:11,240
Another thing that we've seen a lot of the
ear saver bands, so if you have to wear a

535
00:46:11,240 --> 00:46:16,020
mask for an extended period of time, it can
really rub on the back of your ears and be

536
00:46:16,020 --> 00:46:20,970
uncomfortable. So, they're printing out these
plastic pieces that hold the mask around your head.

537
00:46:20,970 --> 00:46:26,520
So, it keeps it off of your ears. They're
thin, they're quick and easy to print. It

538
00:46:26,520 --> 00:46:31,690
doesn't necessarily require a high quality.

It's just pulling back the, the straps.

539
00:46:31,690 --> 00:46:36,870
So, it's a very simple application that I
know some students that have told me that

540
00:46:36,870 --> 00:46:42,800
they're printing these on their printer at
home and and giving them to a mom or a sister

541
00:46:42,800 --> 00:46:49,490
that's a nurse. And they're serving a great purpose. So, the,

542
00:46:49,490 --> 00:46:54,160
the best application is not always the most
complicated ones. Sometimes there's very simple

543
00:46:54,160 --> 00:46:57,310
things that could be solved by 3D printing.

544
00:46:57,310 --> 00:47:07,340
Everybody, you know, still talking about ventilators
and we're still trying to, to get these parts.

545
00:47:07,340 --> 00:47:13,720
We did have a time about a question for about
ten to fifteen minutes each. So you must be

546
00:47:13,720 --> 00:47:15,190
printing some of these.

547
00:47:15,190 --> 00:47:18,730
Are you printing some some at home on your
printers?

548
00:47:18,730 --> 00:47:24,640
So, ten to fifteen minutes is really not a
long, long time to be able to print some of

549
00:47:24,640 --> 00:47:33,060
these parts and get them to help again that
extended wear of the PPE that's required.

550
00:47:33,060 --> 00:47:39,400
So, one of our participants just hit a
thousand of these printed the other day. So

551
00:47:39,400 --> 00:47:41,290
that's really, really amazing.

552
00:47:41,290 --> 00:47:48,160
Both that you're able to to do that as a community
member, be able to have that impact and be

553
00:47:48,160 --> 00:47:54,610
able to to help out those that are that are
happening to be in the hospitals and working

554
00:47:54,610 --> 00:48:00,070
so that's really awesome.

555
00:48:00,070 --> 00:48:10,230
Ventilators are a much more complicated part
and component. Ventilators require FDA clearance

556
00:48:10,230 --> 00:48:16,320
so it's not something that's gonna get a waiver
to be able to to happen.

557
00:48:16,320 --> 00:48:21,680
Instantly, and it requires consistent high
quality parts.

558
00:48:21,680 --> 00:48:27,250
So these are our parts that are gonna have
to have a lot more engineering input and

559
00:48:27,250 --> 00:48:32,370
robust testing to make sure that they're not hurting rather than helping because we have

560
00:48:32,370 --> 00:48:34,510
a little bit more time.

561
00:48:34,510 --> 00:48:40,240
So we're, you know, in the place where we can can think about, what are the best

562
00:48:40,240 --> 00:48:43,390
application, can we print something and be able to use it?

563
00:48:43,390 --> 00:48:49,980
I did find an article where there's a Poland company that has 3D printed a ventilator,

564
00:48:49,980 --> 00:48:53,320
but there's still advising as a last resort device.

565
00:48:53,320 --> 00:49:03,690
So it's not as robust as traditional ventilators and needs potentially more testing.

566
00:49:03,690 --> 00:49:07,410
And one last application for the ventilator parts,

567
00:49:07,410 --> 00:49:12,490
we have a question about the other parts for a single use only and whether that's true

568
00:49:12,490 --> 00:49:15,850
for 3D applications and in medicine.

569
00:49:15,850 --> 00:49:21,710
The main reason why they were single use only
is because they couldn't be cleaned.

570
00:49:21,710 --> 00:49:32,520
And the appropriate sterilization procedures
weren't there so it's, it's a risk of whether,

571
00:49:32,520 --> 00:49:34,940
you know, it's clean or you don't know it's
cleaned.

572
00:49:34,940 --> 00:49:41,480
So, without some testing to be able to know
that these parts are clean, then it would

573
00:49:41,480 --> 00:49:47,680
have to be single use only. However, there
are other medical applications where you can

574
00:49:47,680 --> 00:49:48,680
reuse

575
00:49:48,680 --> 00:49:54,160
maybe it's a a metal part, or some other material
that's been cleaned.

576
00:49:54,160 --> 00:50:01,640
And so one last application that Dr. Srinivasan found in a news article, where there's

577
00:50:01,640 --> 00:50:08,480
actually a lab in Ohio that's partnered with
a 3D printing company to print the test

578
00:50:08,480 --> 00:50:09,480
swabs

579
00:50:09,480 --> 00:50:14,920
and so this is the type of printer where I
showed you the application of printing, the,

580
00:50:14,920 --> 00:50:19,760
the teeth to have the retainers made. This
is the printer that would be printing those

581
00:50:19,760 --> 00:50:24,900
teeth, and they repurposed the printer
to create these test swabs.

582
00:50:24,900 --> 00:50:26,910
So,
you can see in the image,

583
00:50:26,910 --> 00:50:30,920
there's quite a few printing at the time,

584
00:50:30,920 --> 00:50:32,910
and they've tested these,

585
00:50:32,910 --> 00:50:41,440
these swabs US health in normal health have
gone through and patented the design and put it

586
00:50:41,440 --> 00:50:44,380
through the appropriate regulatory clearances,

587
00:50:44,380 --> 00:50:45,410
however,

588
00:50:45,410 --> 00:50:47,170
one thing that's important

589
00:50:47,170 --> 00:50:52,390
point out for this application is the lab

that's printing these there are registered

590
00:50:52,390 --> 00:50:58,110
lab with appropriate quality controls and
cleanliness in their lab where they're printing

591
00:50:58,110 --> 00:51:00,490
the parts to where they're able to produce
these.

592
00:51:00,490 --> 00:51:06,010
So these wouldn't necessarily be something
that you would print at home, because it needs

593
00:51:06,010 --> 00:51:13,260
that robust quality cleanliness.

594
00:51:13,260 --> 00:51:20,420
So just bringing up a summary of added manufacturing
and see if there's any more questions from

595
00:51:20,420 --> 00:51:22,210
the participants. 3D,

596
00:51:22,210 --> 00:51:26,460
printing is a really powerful tool where you
can build parts that are custom,

597
00:51:26,460 --> 00:51:29,940
small batch and lots of different materials

598
00:51:29,940 --> 00:51:34,860
you can print them with and can provide a
lot of great solutions to challenges,

599
00:51:34,860 --> 00:51:35,860
particularly like,

600
00:51:35,860 --> 00:51:37,980
the one that we're going through right now,

601
00:51:37,980 --> 00:51:40,780
where it's a rapid evolving situation,

602
00:51:40,780 --> 00:51:44,700
where we need these applications quickly,

603
00:51:44,700 --> 00:51:49,100
and people are getting involved to where they're
providing robust designs

604
00:51:49,100 --> 00:51:55,560
and quality control, in order to be able to
make sure that the printed parts are serving

605
00:51:55,560 --> 00:52:00,240
their purpose and really providing value.

606
00:52:00,240 --> 00:52:11,800
So, does anybody have any other questions
or anyone want to chime in on anything?

607
00:52:11,800 --> 00:52:21,380
Yeah,
I think there is a question about an application

608
00:52:21,380 --> 00:52:22,380
so from Laura,

609
00:52:22,380 --> 00:52:23,380
so,
in fact,

610
00:52:23,380 --> 00:52:24,510
the many applications,

611
00:52:24,510 --> 00:52:27,720
it should be single application,

612
00:52:27,720 --> 00:52:28,900
but again,

613
00:52:28,900 --> 00:52:32,460
single use again,

614
00:52:32,460 --> 00:52:36,260
there are some applications for example,

615
00:52:36,260 --> 00:52:38,880
prosthetics can be used

616
00:52:38,880 --> 00:52:57,110
I mean, many times, but you said again, user specific. So most most of the cases is a single,

617
00:52:57,110 --> 00:53:02,130
but again, it depends on the application.

618
00:53:02,130 --> 00:53:03,830
Yeah,
I mean,

619
00:53:03,830 --> 00:53:05,160
the different application,

620
00:53:05,160 --> 00:53:06,160
also,

621
00:53:06,160 --> 00:53:08,940
the trend to implant implants,

622

00:53:08,940 --> 00:53:10,800
and then the medicine I saw some,

623
00:53:10,800 --> 00:53:11,800
some companies,

624
00:53:11,800 --> 00:53:13,280
they're trying to make medicine,

625
00:53:13,280 --> 00:53:16,170
which will be basically efficient.

626
00:53:16,170 --> 00:53:21,060
So that all depends on the application.

627
00:53:21,060 --> 00:53:22,720
But most cases,

628
00:53:22,720 --> 00:53:23,720
yes.

629
00:53:23,720 --> 00:53:28,190
The big benefit is that it can be customized
to a particular person,

630
00:53:28,190 --> 00:53:30,930
whether it's a prosthetic implant or,

631
00:53:30,930 --> 00:53:37,780
as Ahsan mentioned the medicine that a combination
of drugs that of person can

632
00:53:37,780 --> 00:53:42,810
be prescribe is that what you're saying?
Yeah, yeah. That's right.

633
00:53:42,810 --> 00:53:43,810

I mean,

634
00:53:43,810 --> 00:53:46,190
based on the patient,

635
00:53:46,190 --> 00:53:53,800
and some patients need maybe multiple drugs
at the same time,

636
00:53:53,800 --> 00:54:09,130
so they're basically can make one by combining
and having different (audio unclear)

637
00:54:09,130 --> 00:54:19,680
So this becomes to be mostly patient, especially
on the patient data level data.

638
00:54:19,680 --> 00:54:28,900
So we have another medical question. So have
they started printing actual human parts?

639
00:54:28,900 --> 00:54:33,940
So they were seeing some applications where they're
using on mice or dogs.

640
00:54:33,940 --> 00:54:41,160
So, do you guys know any applications where
they're using building parts for humans?

641
00:54:41,160 --> 00:54:52,480
Yeah, actually, especially implants I have
seen in Europe they actually used a varying

642
00:54:52,480 --> 00:54:55,350
list of what you (audio unclear)

643
00:54:55,350 --> 00:55:05,670
They 3D printed a part. Again was sunset

based on the patient and you can actually

644
00:55:05,670 --> 00:55:11,010
set a it was,

645
00:55:11,010 --> 00:55:23,400
it was perfectly fit on the patient because
of the detail.

646
00:55:23,400 --> 00:55:24,550
The other,

647
00:55:24,550 --> 00:55:25,700
I think,

648
00:55:25,700 --> 00:55:30,670
FDA probably approved during the process will
be some of the

649
00:55:30,670 --> 00:55:31,990
I mean,

650
00:55:31,990 --> 00:55:35,970
implants or styles some bones in the face.

651
00:55:35,970 --> 00:55:41,270
I saw that there is some application process.

652
00:55:41,270 --> 00:55:48,210
But in the era of the day,

653
00:55:48,210 --> 00:55:54,770
I have seen some placement of (audio unclear) actually,

654
00:55:54,770 --> 00:56:00,310
some patients or whose style was getting that
was the pressure on play.

655
00:56:00,310 --> 00:56:12,180
And so, then, actually, they replaced it with
polymer and that the patient was perfectly

656
00:56:12,180 --> 00:56:13,200
clear.

657
00:56:13,200 --> 00:56:20,150
So we have another question about getting
started with 3D printing. So if you wanted

658
00:56:20,150 --> 00:56:25,820
to get started, what software would you have them
start with?

659
00:56:25,820 --> 00:56:41,340
So I I think, okay, the software yeah. Software,
you need the (audio unclear) software first, because that's

660
00:56:41,340 --> 00:56:45,120
where you design your part.

661
00:56:45,120 --> 00:56:52,980
So first thing would be stuff that could be
solid (audio unclear) would be some other, any other

662
00:56:52,980 --> 00:57:02,920
data source. Yes. After that can be used for
a more advanced design would be.

663
00:57:02,920 --> 00:57:07,840
So, it works a similar type but let me get.

664
00:57:07,840 --> 00:57:08,840
Yeah,

665

00:57:08,840 --> 00:57:12,940
but there are some gaps software should be
somewhat safe,

666
00:57:12,940 --> 00:57:13,940
but yeah,

667
00:57:13,940 --> 00:57:15,260
for design software,

668
00:57:15,260 --> 00:57:27,680
there's the first question. And then it actually
comes with software to convert that file to

669
00:57:27,680 --> 00:57:29,450
machine readable.

670
00:57:29,450 --> 00:57:36,560
So that the software comes with the printer.

671
00:57:36,560 --> 00:57:46,360
He should be fine. Alright Thank you everyone
for coming to our talk. I put all of our email

672
00:57:46,360 --> 00:57:48,360
addresses up on the screen.

673
00:57:48,360 --> 00:57:53,920
So, if you have further questions, please
reach out, like I mentioned, if you want to

674
00:57:53,920 --> 00:57:59,530
come see the lab, when we can all gather again,
let us know, and you're welcome to come see

675
00:57:59,530 --> 00:58:00,530
the lab.

676
00:58:00,530 --> 00:58:07,880
Great. Thank you so much and please all of our
participants to join me in a virtual round

677
00:58:07,880 --> 00:58:10,550
of applause for Dr. Gockel, Dr. Mian and Dr. Srinivasan, this is so interesting today.

678
00:58:10,550 --> 00:58:15,150
We really appreciate you showing your expertise
and also sharing the contact information for

679
00:58:15,150 --> 00:58:22,580
follow up. I just went over to each one of
these lectures is archived. You could

680
00:58:22,580 --> 00:58:28,440
access the live streaming site at Wright. State.

681
00:58:28,440 --> 00:58:33,540
You can also access it through the CORE scholar,
with Wright State university library.

682
00:58:33,540 --> 00:58:41,230
You could follow up with any of the panelists,
or with myself if you have any questions about

683
00:58:41,230 --> 00:58:45,230
how to locate those archives. I just wanted to let you know that the series
will continue again next week on Thursday

684
00:58:45,230 --> 00:58:46,230
at four o'clock.

685
00:58:46,230 --> 00:58:54,010
We have three of our colleagues, plus a panel
from the Boonshoft school of medicine, Department

686

00:58:54,010 --> 00:58:58,810
of population and public health sciences,
and they're gonna be talking about COVID-19

687
00:58:58,810 --> 00:59:00,120
and its impact on vulnerable population.

688
00:59:00,120 --> 00:59:05,260
So we have to see many of you back here again
next week. Once again, thank you for joining us.

689
00:59:05,260 --> 00:59:10,260
Thank you to our esteemed panelists. Very
interesting and they did such a great job. Take care everybody and

690
00:59:10,260 --> 00:59:18,590
have a wonderful week. Thank you. Thank you.