Project RemotePI: COVID-19 Mitigation-Compliant Operations on OMEGA and OMEGA EP

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The COVID-19 pandemic presented an unprecedented challenge to our highly productive experimental facility. While the Omega Laser Facility was in standby mode for "NY State on PAUSE," our operations team evaluated and modified the Omega operating processes to deliver "normal" operational throughput with most scientists and some support staff working remotely. Since the Omega user base is located around the globe, the experiment-planning process was already conducted largely via online, e-mail, and video conferencing methods; therefore, little change to that was necessary. However, shot-day operations required extensive changes. Shot-day transactions between the Principal Investigators (PI's) and the operations crew had been done in person only, requiring the PI's to be on-site. New travel restrictions meant this was seldom possible. Additionally, new occupancy restrictions to support social distancing limited the number of personnel on-site.

To address these new constraints, the remotePI protocol was implemented. The primary objective was to facilitate PI-to-Operations shot-day transactions while complying with COVID-19 mitigation rules (social distancing and travel limitations) by implementing a minimal set of changes to our existing processes—changes that were implementable on a very short development cycle, easy to learn, and used only existing and available equipment, particularly for the off-site participants. We achieved these goals while supporting efficient operations—meeting or exceeding "usual" Omega levels of effectiveness, availability, and flexibility.

Each OMEGA 60 or OMEGA EP shot cycle is governed by a series of transactions between the PI and the facility. The remotePI system eliminates PI location dependence by creating a virtual venue for these transactions using an intuitive platform and commonly available equipment. The centerpiece of remotePI is an all-day Zoom meeting for each facility, which we dubbed "ShotStream." ShotStream connects the PI to the facility, as well as to collaborators and technical staff. Each day there is one ShotStream opened for each facility, comprising two virtual rooms: one "main room" used as a collaboration space for PI's and another area (the "control room") used exclusively for communication between the PI and the operations crew (see Fig. 1). A simple rule set is implemented to allow concise communication between the PI and Operations crew.

ShotStream provides a venue for all the shot-day transactions between the PI and the facility (see Fig. 2). The audio channel from one of the ShotStream rooms is connected directly to a facility intercom channel, allowing the PI to communicate directly with any of the on-site staff. Screen sharing and video feeds allow the PI to receive important information such as target images, pulse-shape predictions, and shot configuration database changes. Also available on the Zoom are direct video from key diagnostics, such as VISAR/ASBO (velocity interferometer system for any reflector/active shock breakout) cameras, and real-time video of any piece of equipment can also be piped into ShotStream. Final approvals prior to the shot are conducted on ShotStream. Additionally, the PI conducts the pre-watch briefings to the Operations crew on ShotStream. The PI observes Control Room operations during the shot on ShotStream and can participate whenever appropriate. Regardless of their actual location in the world, ShotStream puts the PI into our Control Rooms during the shot. Data from each shot are posted online for the PI to review. Electronic data [e.g., charge-coupled device, image plate, or oscilloscope readouts] have been traditionally available online, but
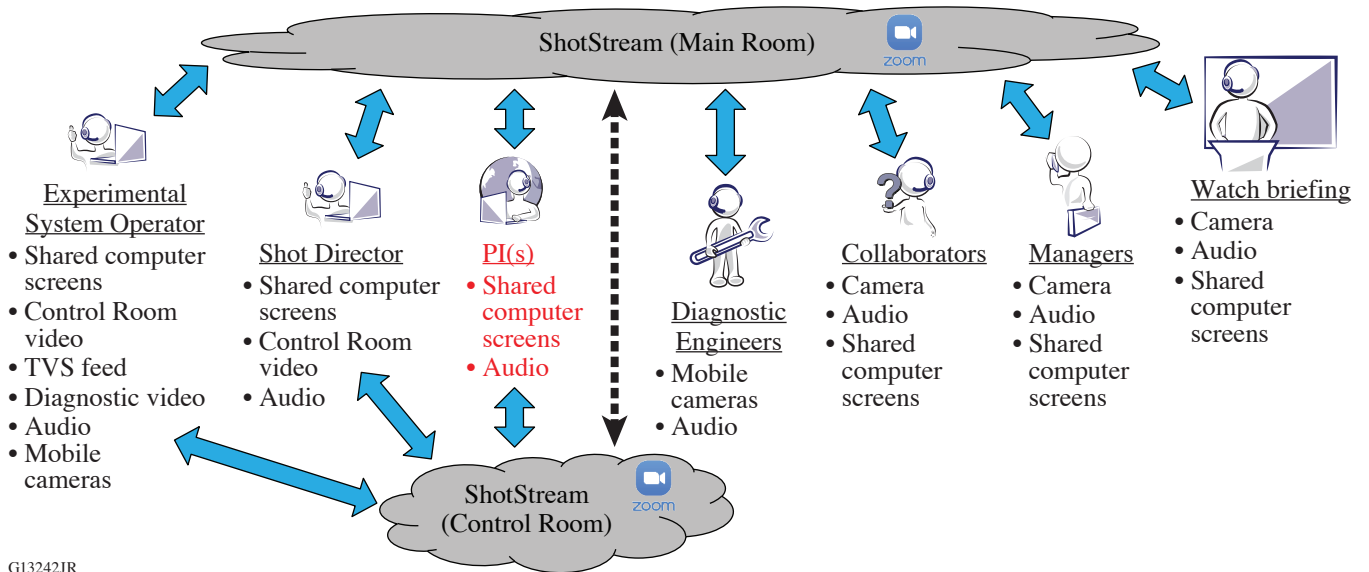
Figure 1

ShotStream virtual facility conceptual layout. The virtual main room is used by all participants as a collaboration area, for crew briefings, etc. The virtual control room is used for direct communication between the PI and shot crew.
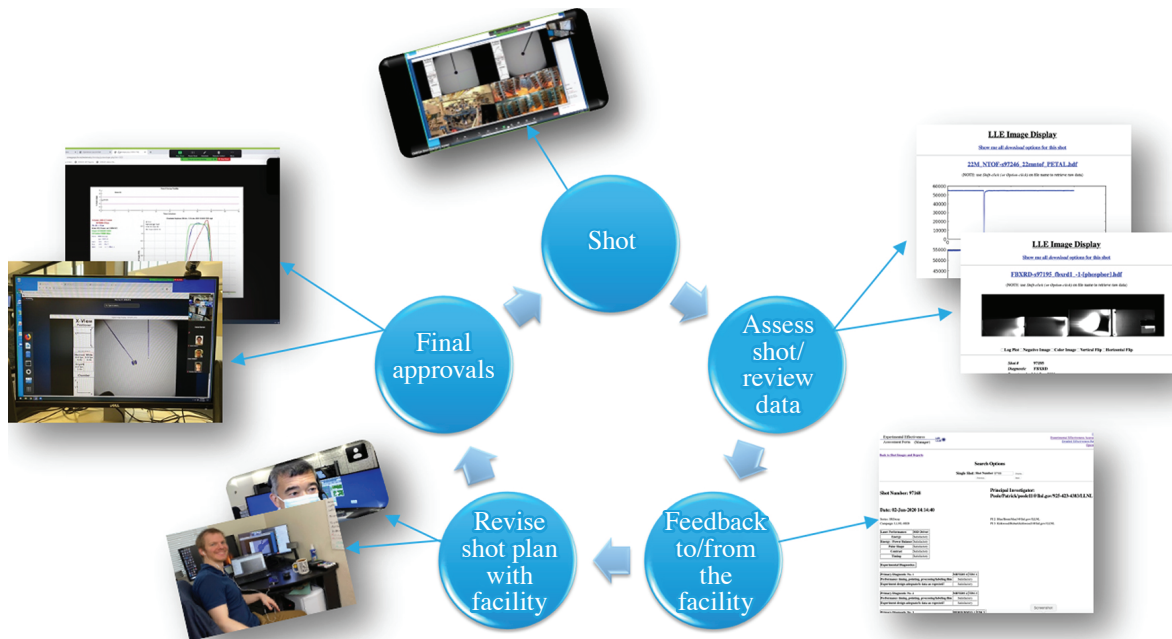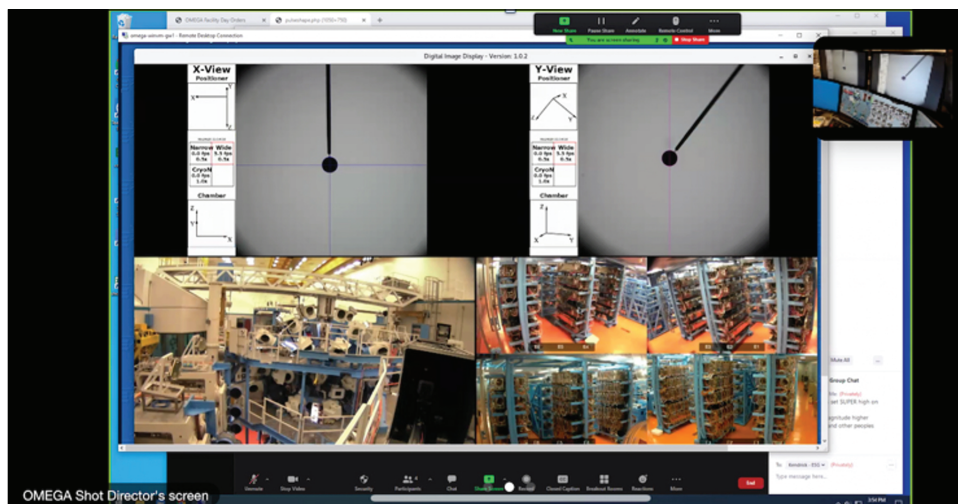

Figure 2

All of the shot-day transactions between the PI and the facility are supported by the remotePI process.

film data usually had been handled in person. Film data are now scanned and posted to the LLE website shortly after each shot. The post-shot feedback paper forms have been replaced with similar online forms for quick and precise feedback to the facility.

Additionally, mobile cameras can be deployed to the field and broadcast on ShotStream to allow on-demand video/audio communications between remote participants (PI's or technical staff) and on-site operators. This supports precise instrument setup and troubleshooting even when the system experts are not on-site.

Today, PI's as well as many support staff and managers use the remotePI system to participate in shot operations on OMEGA 60 and OMEGA EP on a daily basis while complying with the strict social distancing requirements that are essential to COVID-19 mitigation. While the modifications to the system to implement remotePI are modest in scope and now operate with little overhead cost, the software and hardware updates needed to initially deploy the system required participation by many of our support staff, most of whom were working remotely themselves. Key to the success of remotePI, only commonly available equipment (a PC or mobile device with an internet connection) is needed for a PI to fully participate in shot operations. A typical ShotStream user view is shown in Fig. 3.

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Figure 3
Typical ShotStream view shown on a mobile device.

Since resumption of shot operations in June 2020, all OMEGA 60 and OMEGA EP shots have used the remotePI system. Changing to the remotePI protocol does not appear to have adversely affected the availability or effectiveness of our facility. During our first seven months of operations, the effectiveness and availability results on both OMEGA 60 and OMEGA EP are comparable to those of the seven months leading up to the pandemic. After-action reports from PI's have been largely complimentary. Comparison of performance in legacy operations mode (9/1/19–3/22/20) and remote PI operations mode (6/3/20–12/14/20) are shown in Tables I and II. Because of the numerous benefits brought to the facility by remotePI and demonstrated over the past year, including enhanced scheduling flexibility and more efficient use of support resources, LLE plans to continue to make remotePI available in our operational toolkit even after the constraints of the Covid-19 pandemic are lifted.

Table I: Comparison of OMEGA 60 performance pre-/post-COVID-19.

Date Range	Number of Shots	Average Availability	Average Effectiveness
9/1/19 to 3/22/20	648	93.9%	94.9%
6/3/20 to 12/14/20	658	91.1%	94.5%

Table II: Comparison of OMEGA EP performance pre-/post-COVID-19.

Date Range	Number of Shots	Average Availability	Average Effectiveness
9/1/19 to 3/22/20	503	96.7%	95.7%
6/3/20 to 12/14/20	516	93.9%	95.4%