Outline briefly the background to and the aims of the project (500 words max):

Located on the Harwell campus not far from Oxford, Diamond Light Source is the UK's national synchrotron light source that produces extremely bright synchrotron light. The synchrotron light has applications in a large variety of disciplines, one example being diffraction microscopy to recreate protein structures at atomic levels. The brightness of the synchrotron light, which is emitted by electrons traveling around a 550m circumference outer ring, heavily depends on one condition: The motion of the electron beam in the outer ring must be stable, which is the focus of the proposed project. A sophisticated control system measures the position of the electrons using 173 sensors and maintains the trajectory error of the electrons below a few hundreds of nanometers. My supervisor Stephen Duncan has developed a closed loop control system to control the electron beam, but there is a missing piece to this model. How does one accurately measure the performance of the control system in practice? Answering this question would be the main focus of the research project. Currently, the trajectory error is removed by the control system and this prevents assessment of the controllers performance. One possibility is to introduce a non-zero trajectory error, referred to as a reference signal, and measure the ability of the control system to follow the reference signal. The aim of this project is to find reference signals that allow optimal measurement of controller performance. An initial plan is to use the existing model of the control system developed by former students in Matlab, and run simulations of the synchrotron with different reference signals. We would then aim to find values for the reference signal that allow one to accurately measure the performance of the controller (response speed, stability, steady state error etc.). Once this is completed, the next phase would involve running tests on the actual synchrotron, during one of their open machine development days, to validate our results on the real-world synchrotron.. The diamond light source synchrotron is planning to undergo upgrades, and if this project is successful, the new control system would likely be implemented into said upgrades.

Indicate briefly why you would like to take part in this scheme (500 words max):

In short, the control engineering module in the A2 paper has been my favorite topic so far, and I would greatly benefit from the opportunity to apply my pre-existing theoretical knowledge on a problem with practical applications. In addition, the project will give me the opportunity to develop new skills in control theory and programming in the context of an exciting real world problem as opposed to coursework. While developing these skills, I will be working with a large research team in the department; a unique experience that would strengthen my interpersonal skills in the context of research and engineering. Although I have accumulated a strong base of theoretical knowledge through my degree, I recognize that there are differences in the way engineering is conducted in practice vs in theory. Being already interested in control theory, this scheme will give me a great opportunity to understand how the theory applies to real world projects. Overall, the EUROP scheme will greatly enrich my education in engineering science by exposing me to the practical side of topics I enjoy in the course, and give me experience as a member of a research team. Should the project be as enjoyable and successful as I predict, I could also extend the research into a topic for my future 4YP (4th Year Project). In any regard, the

experience and skills built up during this scheme will be great assets in any engineering projects I will pursue in the future.