

**THE SELF ADAPTIVE FLIGHT CONTROL SYSTEMS
SYMPOSIUM**

PROGRAM

WADC AUDITORIUM

WEDNESDAY MORNING, 14 JANUARY 1959

SESSION V

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As Doctor Draper demonstrated yesterday, teachers' remarks and comments are always quantized in fifty minute sessions, so I would like to bow with just a few brief comments this morning. As Dr. Draper also promised, I won't talk very long because I know you are interested in hearing from the people who have actually done some work, and this morning we are going to have the privilege of hearing from five different organizations.

One job of the University ought to be to define problems and to orient the field and evaluate work in the field. It seems to me that if ever an area required or demanded a definition of the problem, the area of adaptive systems may fall in this category. Like many other organizations, we have done a lot of arguing about what constitutes an adaptive system. I came here without any real definition of an adaptive system! Yesterday I sat in the auditorium with Doctor Aseltine, who will be chairman of this afternoon's session, and we arrived at a definition of an adaptive system which I think has some merit. We think it does anyway. We were a little perturbed yesterday because, if you look at the MIT system and the Minneapolis-Honeywell system and some of the other very interesting pieces of work which we saw, you find that if you re-draw these systems a little differently they look like a conventional feedback control system, which we might analyze in our typical graduate course. For example, the MIT system which is startlingly adaptive as you look at it. If you re-draw it you find that this is really, if you have just one variable parameter for example, a two loop system, with a single non-linearity adjusted so that when you drive it with step functions as they do, it behaves in a linear fashion in the overall system. It looks like here we have an intentionally non-linear system or a non-linear system which was purposefully designed. The Honeywell system that we saw yesterday, if you look at it as an intentionally non-linear feedback control system, is perhaps a single loop with two forward paths.

I don't think this should be surprising because the general concept of feedback, as we all know, is completely arbitrary. We can talk about any system as having feedback or not having feedback, depending upon our personal wishes. We can look at it as having one loop, two loops or eight loops if we want so that there is a certain arbitrariness in a feedback configuration to begin with. It seems to us that this thing called adaptivity is an additional degree of arbitrariness. So we would like to define an adaptive feedback system as one which is designed with an adaptive viewpoint.

This sounds superficial when you first hear it but there really is considerable merit because nobody has any idea how to design a system with

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an intentional non-linearity introduced into the system to obtain desirable performance. By this adaptive viewpoint one obtains a logical, simple, and straightforward technique toward the inclusion of a non-linear element within the system to obtain some reasonable performance specifications or meet some reasonable optimization criteria. We would say, particularly, that this was an intentionally non-linear feedback system of any number of loops you may wish designed with an adaptive viewpoint.

I don't know whether the systems you are going to hear about this morning will fall in this category or not. I don't think that this sort of facetious definition, as it may seem on the surface, takes anything away from the great importance of this subject of adaptive systems. What we want, above all, is a new viewpoint toward feedback control system design and it seems to me that the great importance of this subject of adaptive systems is that it gives us another way to get into the design problem. Essentially, it broadens the class of problems and the class of systems which we are now able to circumspect and design intelligently.

Doctor Aseltine, I am sure, will expand on these comments this afternoon and perhaps by that time you can demonstrate where we are wrong.