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OPTIMIZATION OF COMPOSITION AND PROCESSING PARAMETERS FOR ALLOY DEVELOPMENT: A STATISTICAL MODEL-BASED APPROACH

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Abstract. We describe the second step in a two-step approach for the development of new and improved alloys. The first step, proposed by Golodnikov *et al* [3], entails using experimental data to statistically model tensile yield strength and the 20th percentile of the impact toughness, as a function of alloy composition and processing variables. We demonstrate how the models can be used in the second step to search for combinations of the variables in small neighborhoods of the data space, that result in alloys having optimal levels of the properties modeled. The optimization is performed via the efficient frontier methodology. Such an approach, based on validated statistical models, can lead to a substantial reduction in the experimental effort and cost associated with alloy development. The procedure can also be used at various stages of the experimental program, to indicate what changes should be made in the composition and processing variables in order to shift the alloy development process toward the efficient frontier. Data from these more refined experiments can then be used to adjust the model and improve the second step, in an iterative search for superior alloys.

1. Introduction.

In recent work, Golodnikov *et al* [3] developed statistical models to predict the tensile yield strength and toughness behavior of high strength low alloy (HSLA-100) steel. The yield strength was shown to be well approximated by a linear regression model. The alloy toughness (as evaluated by a Charpy V-notch, CVN, at $-84°C$ test), was modeled by fitting separate quantile regressions

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